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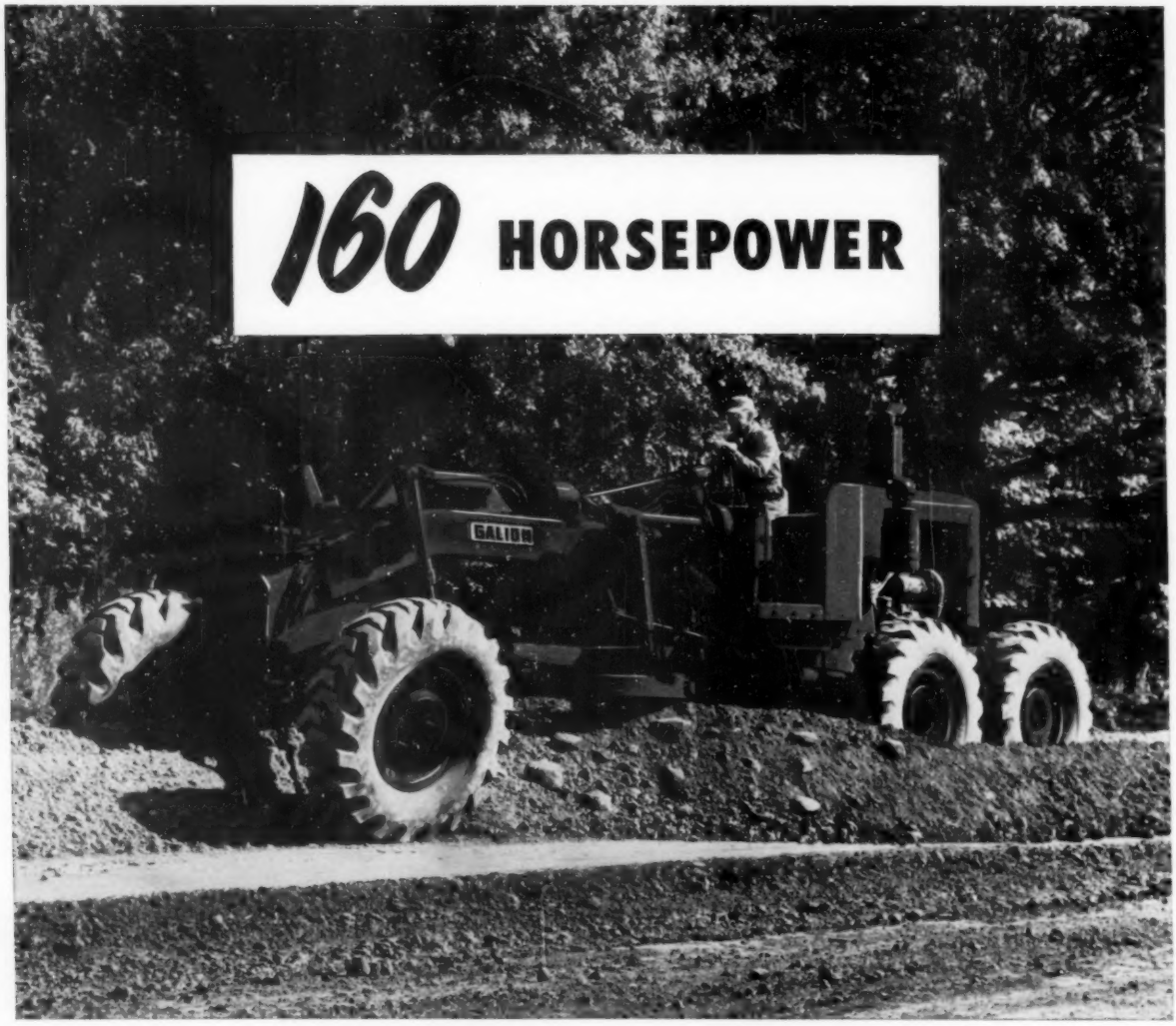
F. N. Hveem is Research and Materials Engineer for the California Division of Highways. In his present position since 1951, he has worked on maintenance and construction phases also. More data about him on page 18.



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How a Four-Man Crew laid 1500 feet a day of CLOW Bell-Tite® pipe through Florida swampland

CLOW cast iron pipe, with the sensational Bell-Tite joint, proved its advantages conclusively in this Clearwater, Florida, installation.

That a four-man crew was able to lay this CLOW Bell-Tite pipe at 1500 feet a day under these adverse conditions is definite evidence of the time, labor and money-saving advantages of this CLOW-designed joint. Two men worked in the trench—often in 3 feet of water. One man lubricating and aligning the joints, the other assembling with a pinch bar. A crane operator and a hook-up man completed the crew.

CLOW Bell-Tite forms a pressure-tight joint—instantly—no bolts or follower glands required. Under practically all conditions, it is the fastest, easiest and most economical pipe for water main installation. Underwriters' Laboratories Inc. listed in diameters 3- through 24-inch.

Shows simple assembly of CLOW Bell-Tite joint. Just wipe clean, lubricate and push spigot into the bell. When painted yellow stripe is no longer visible, joint is bottle tight.

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Contractor: Hancock Pipe Company, Clearwater, Fla.

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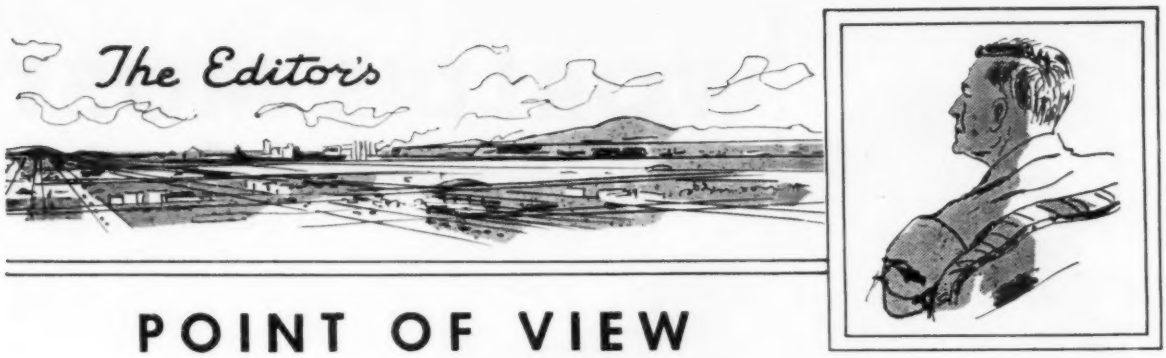


POINT OF VIEW

A Prosperous and Happy New Year to All

A NEW YEAR STARTS about the time our readers receive this issue of PUBLIC WORKS. To them all we wish a Prosperous and Happy New Year; lots of interesting work; opportunity; better pay and greater recognition of the important work that engineers perform. And whatever we can do to further the attainment of these goals is our privilege and pleasure.

Making Power Lines Less Vulnerable to Storms

EVERY ONCE in a while we say something about those overhead power lines which are so vital to modern living and so vulnerable to wind and storm. We have heard a lot of reasons why it is impossible to do anything else than hang wires on poles: Where else would you hang them? We still think they should go pretty much underground and preferably in the area between the sidewalk and the curb, where there is such an area. This would keep storms away from the wires and would keep the repairmen out of the street. However, the places that need underground services the worst are the fully electrified suburban and development residential areas; when the power goes off on a cold winter week-end, you create about as much hazard to public health as if the city water supply were contaminated. In these areas, workmen in the street are not such a problem as in congested areas and there is even less reason for that old excuse.

With the growing dependence on electricity for living, it is past time to take a look at what can be done—not at reasons why it isn't possible.

Better Training for Engineers

THERE HAS BEEN much discussion about the courses that should be given to college students to make them into good engineers. A good deal of this comment has related to sanitary engineering training. Electives and options have been suggested and disapproved just about as often. To complicate the situation, consideration is often given to preparation for a graduate degree, even though this may possibly result in unbalanced training for the man who does not seek an advanced degree.

To one who is no teacher, the matter does not seem nearly so complicated. The first job of undergraduate training is to make a good engineer. Sanitary engineers should be, basically, civil engineers. Undergraduate training should be intended primarily to produce a well-qualified engineer—not necessarily an expert in any field, but able to make a living and progress in his chosen field, with credit to his profession.

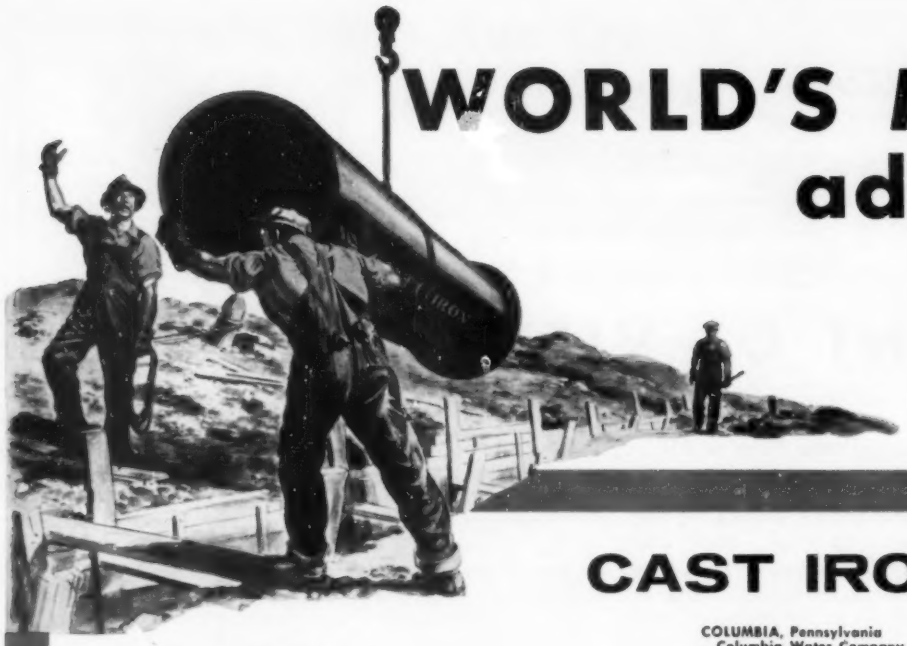
It is desirable to have post graduate training for as many engineers as possible; but the requirements for entering such training should not determine what undergraduate training is to be. The tail ought not wag the dog. Post-graduate training programs should be adjusted, if necessary, to take the products of an effective standard four-year engineering course and to turn such products into more finished and useful material.

First Cost and Final Cost

WHEN YOU buy a piece of public works equipment, you must consider not only the first cost but the operating features, repairs, maintenance, replacements and down-time for the whole life of the machine. When you buy a length of water pipe, you buy also the properties of that pipe which require repair, digging up, and loss of water by leakage. When you buy a sewage treatment plant, you buy also the cost of operating it and the degree of treatment effectiveness that it provides.

But in considering these factors, another side of the picture must be considered—proper size and capacity. An undersize tractor on dirt moving or sanitary fill will cost a lot more to operate and maintain than a properly sized one; a water pipe operating under a pressure greater than it was designed for can be expected to give more trouble and a pipe too small will raise pumping costs; a sewage treatment plant that is overloaded will not provide the desired degree of treatment and may cost more to operate.

So in purchasing public works plants, equipment and materials, be sure first that the size is right, that false economy is not dictating purchase of inadequate size or capacity; then be very sure that the final cost is right. First cost is not always very important; over the life span of use, repairs and maintenance costs can change that first cost picture so you will never recognize it.



WORLD'S MOST adds 20

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*ADRIAN, Michigan
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ALBANY, New York
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ALBANY, New York
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Alexandria Water Company

ALLENTOWN, Pennsylvania
Bureau of Water

*ALTON, Illinois
Union Electric Company, Gas Division

ATLANTA, Georgia
Atlanta Gas Light Company

BALTIMORE, Maryland
Bureau of Water, Dept. of Public Works

BALTIMORE, Maryland
Baltimore Gas and Electric Company

*BANGOR, Maine
Citizens Utilities Company, Gas District

*BETHLEHEM, Pennsylvania
The United Gas Improvement Company

BOSTON, Massachusetts
Public Works Dept., Water Division

BOSTON, Massachusetts
Boston Consolidated Gas Co.

BOUND BROOK, New Jersey
Public Service Electric & Gas Co.

BRIDGEPORT, Connecticut
Bridgeport Gas Light Company

BUFFALO, New York
Dept. of Public Works, Div. of Water

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Cambridge Water Board

*CARLISLE, Pennsylvania
The United Gas Improvement Co., Gas Division

*CATASAUQUA, Pennsylvania
The United Gas Improvement Company

*CHAMBERSBURG, Pennsylvania
Borough of Chambersburg, Gas Department

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South Carolina Electric & Gas Co.

CHICAGO, Illinois
Peoples Gas Light & Coke Company

CHICAGO, Illinois
Water Works Department

CINCINNATI, Ohio
Cincinnati Gas & Electric Co.

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Columbia Water Company

DETROIT, Michigan
Board of Water Commissioners

DETROIT, Michigan
Michigan Consolidated Gas Co.

ELIZABETH, New Jersey
Elizabethtown Consolidated Gas Co.

EVANSVILLE, Indiana
Southern Indiana Gas & Electric Co.

FALL RIVER, Massachusetts
Fall River Gas Works Company

FREDERICK, Maryland
City of Frederick Water Dept.

FREDERICK, Maryland
Frederick Gas Company, Inc.

CITY OF FREDERICKSBURG, Virginia
Gas Department

*HAGERSTOWN, Maryland
Hagerstown Gas Company

HALIFAX, Nova Scotia
Public Serv. Co., Public Water Supply

*HARRISBURG, Pennsylvania
The United Gas Improvement Co., Harrisburg Gas Div.

HARTFORD, Connecticut
The Hartford Gas Company

HARTFORD, Connecticut
Water Bureau, Metropolitan District

HUNTSVILLE, Alabama
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*LAMBERTVILLE, New Jersey
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MADISON, Indiana
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The Mount Holly Water Company

*NANTUCKET, Massachusetts
Nantucket Gas & Electric Company

NASHUA, New Hampshire
Pennichuck Water Works

NASHVILLE, Tennessee
Waterworks Department

NEW BRUNSWICK, New Jersey
Public Service Electric & Gas C

*NEWBURGH, New York
Water Department

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Public Service Electric & Gas Co.

*NEW YORK, New York
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Dept. of Water, Gas & Electricity

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Philadelphia Electric Co., Gas Dept.

*NORWICH, Connecticut
Department of Public Works, Gas Division

*OTTAWA, Ontario
Ottawa Gas

PAINESVILLE, Ohio
City of Painesville, Gas Distribution Dept.

PEORIA, Illinois
Central Illinois Light Company

PHILADELPHIA, Pennsylvania
Dept. of Public Works, Bureau of Water

PHILADELPHIA, Pennsylvania
Philadelphia Gas Works Co.

PITTSBURGH, Pennsylvania
Bureau of Water, Dept. of Public Works

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Plymouth Gas Light Company

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Pottsville Water Company

*POUGHKEEPSIE, New York
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PROVIDENCE, Rhode Island
Providence Gas Company

QUEBEC, Quebec
Quebec Power Co., Gas Division

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Division of Water & Sewers

ST. JOHN, New Brunswick
Water & Sewerage Department

ST. LOUIS, Missouri
Dept. of Public Utilities, Water Div.

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*SANDUSKY, Ohio
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SAVANNAH, Georgia
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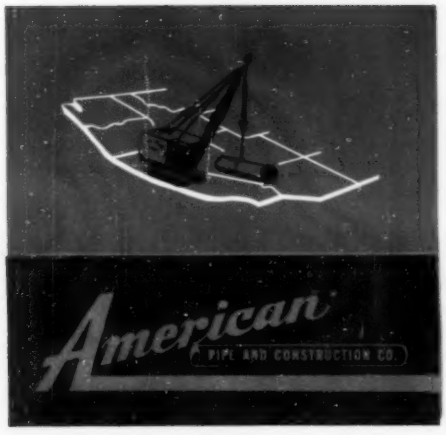
The performance record of this type of reinforced concrete cylinder pipe has been so outstanding throughout the West that Salem can be confident that this water "growth line" will be giving efficient, economical service for many, many years to come.

Strength, permanence, sustained high carrying capacity, and trouble-free service are characteristics of American Concrete Cylinder Pipe which make it the right pipe for this forward looking city.

When planning your future water "growth lines," look to American's quality pipe line products, extensive production facilities and half century of experience.

Ask for complete information concerning the particular class of pipe that will meet your design requirements.



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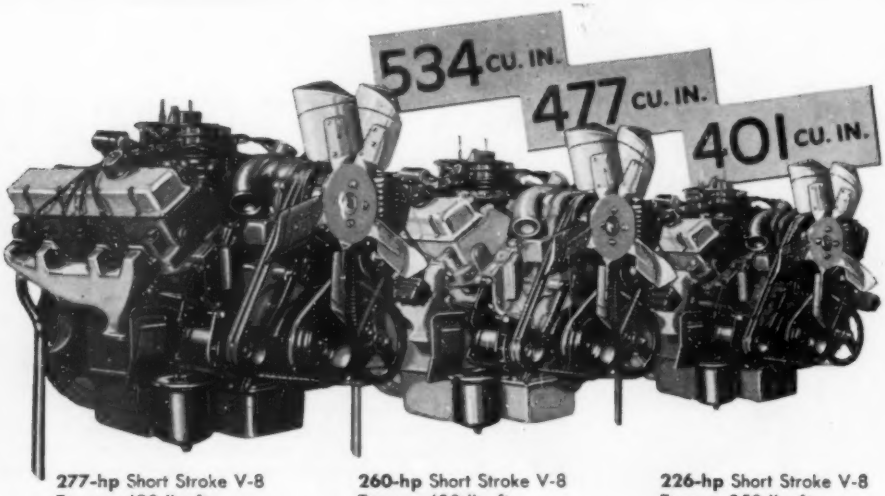

277-hp Short Stroke V-8
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@ 1800-2300 rpm

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@ 1800-2300 rpm

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GVW's up to 51,000 lb. For '58, ten new basic series are added to Ford's already extensive Heavy and Extra Heavy Duty line. Four new Tilt Cabs, four new Conventionals, and two new Tandem models offer GVW ratings up to 51,000 lb.

GCW's up to 75,000 lb. New T-950 Tandem is rated for 75,000-lb. GCW. Biggest single-rear-axle models are rated for 65,000-lb. GCW.

Front axle capacities up to 15,000 lb. Choice of three front axles in most new Ford Extra Heavies. Rated capacities of 9,000 lb., 11,000 lb. and 15,000 lb.

Rear axle capacities up to 29,000 lb. Wide choice of rear axles includes single-speed and two-speed, single reduction and double reduction types. Capacities range from 18,000 lb. to 29,000 lb.

Bogie axle capacities up to 38,000 lb. For '58 there are two new Extra Heavy Duty Tandem Axle models. The new T-950 Series features a tandem rear axle assembly rated for 38,000 lb. New T-850 Series offers choice of 28,000- or 34,000-lb. bogies.

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big move for '58

–up to 534 cu. in.

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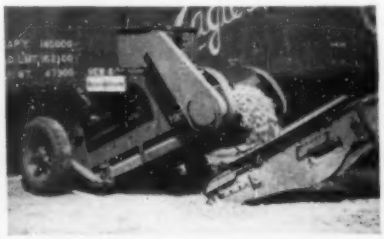
They must be easy to move around the yard . . . easily towed from job to job. They must withstand constant use and frequent movement.

Shown above is the portable conveyor of advanced design, the Barber-Greene 363. Shaft and gear reducer drive—no chains—no sprockets, full swiveling wheels, Acme take-ups and many other exclusive features.

Shown below are other models in Barber-Greene's complete line of cost-cutting conveyors.

Model 374 cuts cost at high capacity. With capacities up to 425 t.p.h., this heavy-duty machine has antifriction bearings, shaft and gearbox drive, hydraulic boom hoist and other features.



Model 358 cuts cost of car unloading. Feeding a conveyor, this car unloader releases cranes and other expensive equipment for other work. Handles gravel, sand, stone, cinders, etc.

Model 362—low-cost, high-quality portable. Three-roll carriers, swivel wheel truck, and many other features not available on conveyors of this low-price range, are standard on the 362.

56-8-PQ

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Mail the coupon today for more details about salt stabilized roads. We'll also send the name of a county engineer in your area who can show you the results he has obtained by using salt stabilization to build roads.

☐ *Please send me your free booklet on salt stabilized roads.*

☐ *I also would like the name of a county engineer near me who has used salt to stabilize roads.*

Name_____
(Please print)

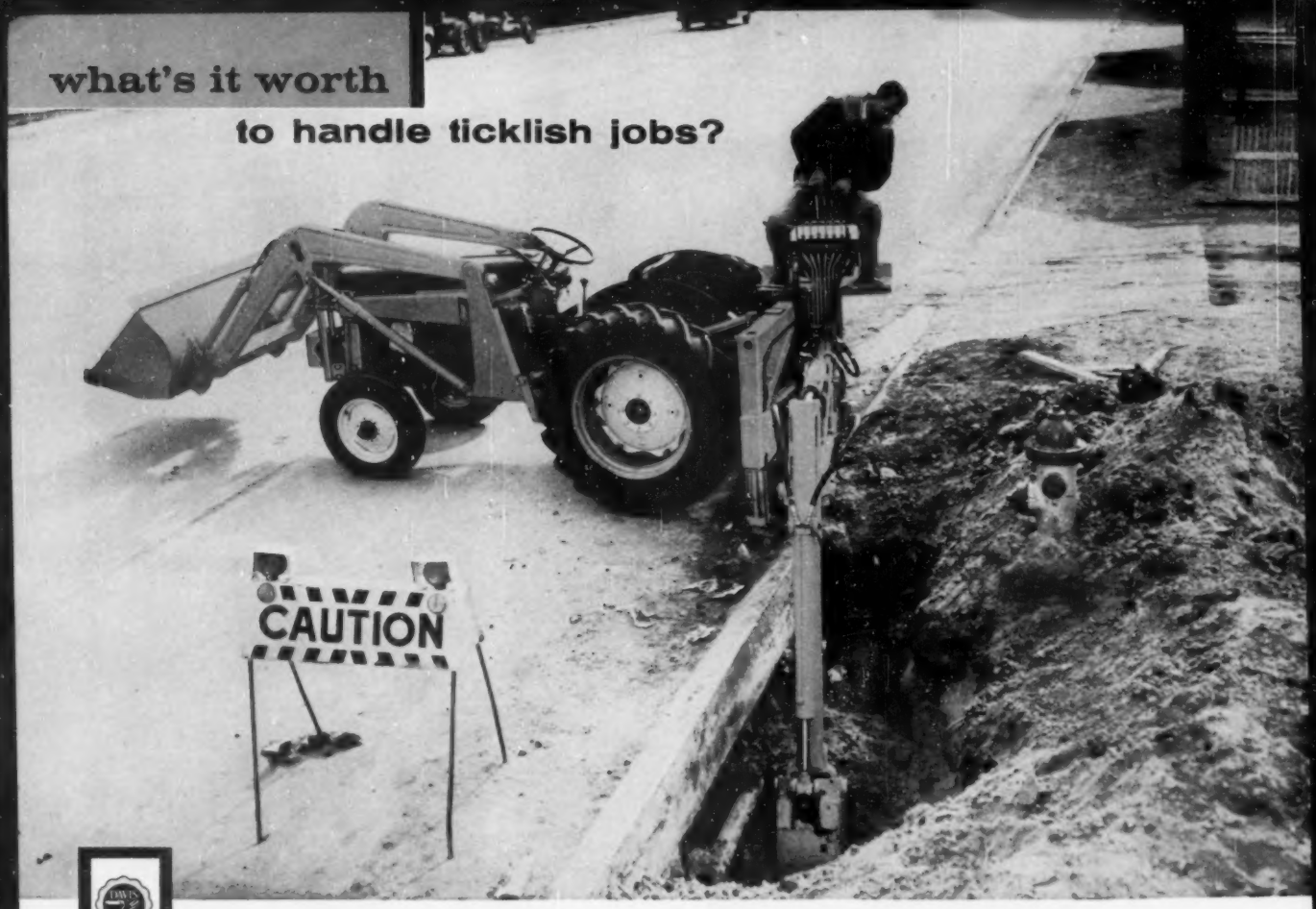
Title_____

Address_____

City_____ Zone____ State_____

MORTON SALT COMPANY
INDUSTRIAL DIVISION
Dept PW-1-58 120 So. LaSalle Street, Chicago 3, Illinois

what's it worth to handle ticklish jobs?



DAVIS BACKHOE lets you work in Tight Spots!

Digs flush when you need to — only the Model 210 Davis Backhoe has the ability to dig flush alongside walls, buildings, fences. Has 200° continuous operating arc.

A Davis Loader and Backhoe combination will put money in your pocket by outperforming any other rig — pound for pound, dollar for dollar.

Digging near pipelines, conduits, utility mains, or other hidden obstructions is always a tough assignment . . . but a Davis Backhoe will let you handle those ticklish jobs easier and quicker with more safety and profit than any other make. Here's why!

DAVIS LETS YOU SEE YOUR WORK — Unobstructed visibility lets you work fast and accurately without having to "feel" your way around concealed objects or depend upon shouts and hand signals for instructions. Both seat and finger-tip controls swing with the boom, so you always face your work.

DAVIS HAS "ALERT" CONTROLS — Boom, dipper stick, bucket, and stabilizer foot respond lightening-fast to your command.

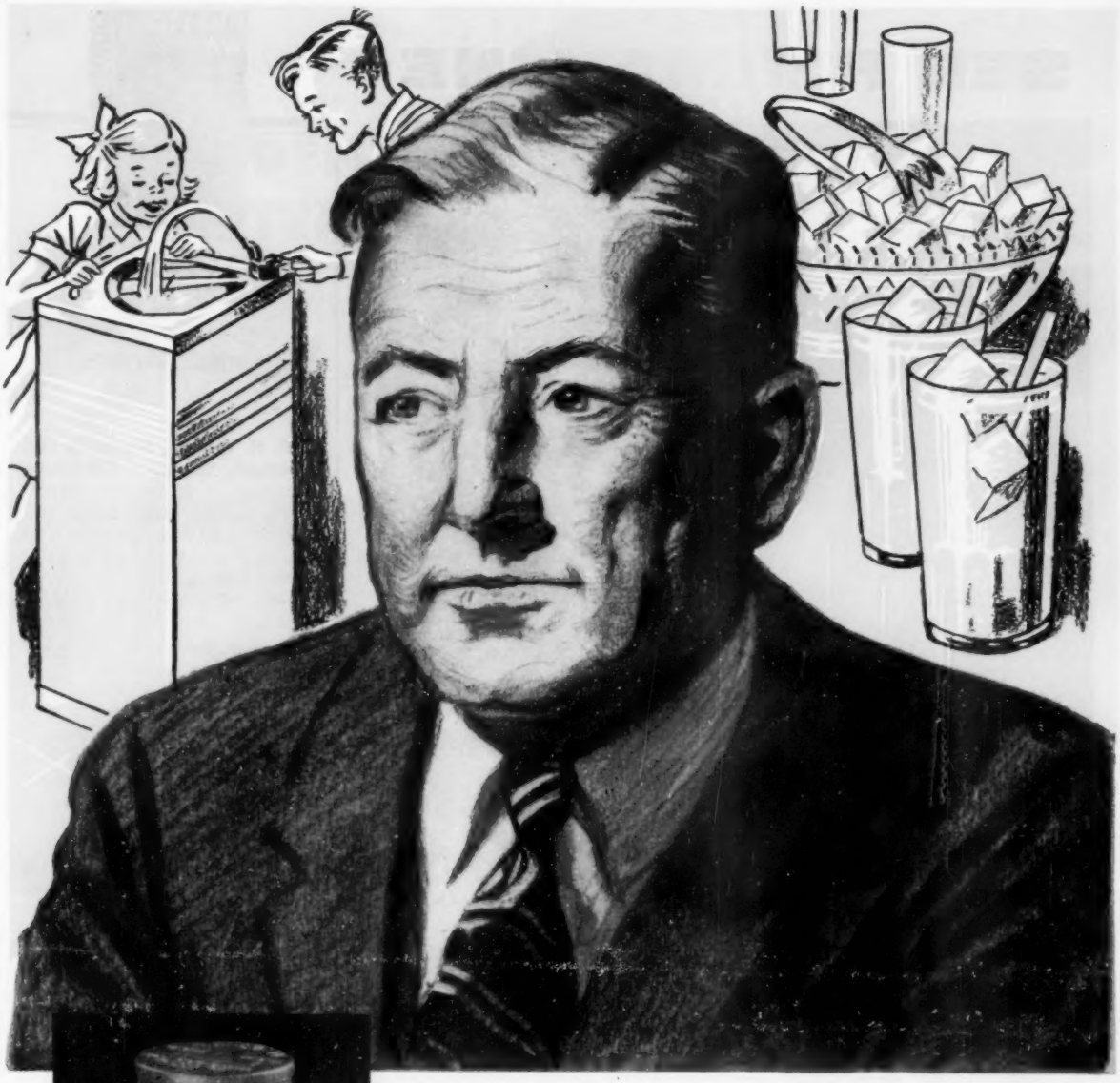
DAVIS GIVES MAXIMUM MANEUVERABILITY — Because of its exclusive flush digging feature, 200° continuous operating arc, and ability to dig at right angles, Davis lets you operate in places inaccessible to other machines. You can often complete jobs in the time it takes other makes to maneuver into position! . . . ***YET DAVIS STILL COSTS LESS THAN MOST OTHER MAKES!***

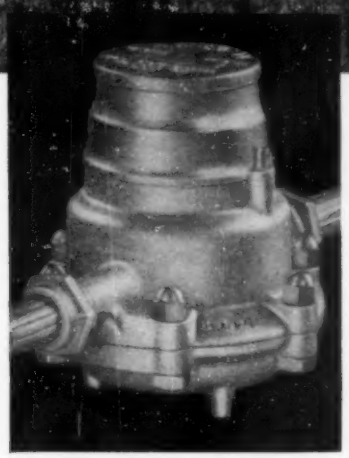
Davis Loaders and Backhoes are available for all popular models of International, Ford, Fordson Major, Ferguson, Case, Massey-Harris, Allis-Chalmers, Oliver, John Deere, Minneapolis-Moline, and Work Bull Tractors.

SOLD AND SERVICED EVERYWHERE BY BETTER DEALERS

For the name of your nearest dealers call Western Union by number and ask for Operator 25 . . . or write direct. Please specify make of tractor.

MASSEY-FERGUSON INDUSTRIAL DIVISION
MASSEY-HARRIS-FERGUSON, INC.
1009 S. WEST STREET • WICHITA 15, KANSAS





American Frost Bottom Meter has frost separable gear train and chamber.

THE WATER COMMISSIONER

GUARDIAN OF THE PUBLIC WATER SUPPLY

He says: "American Meters help us build for the increased water demands of the future by bringing in full revenue for water used today!"

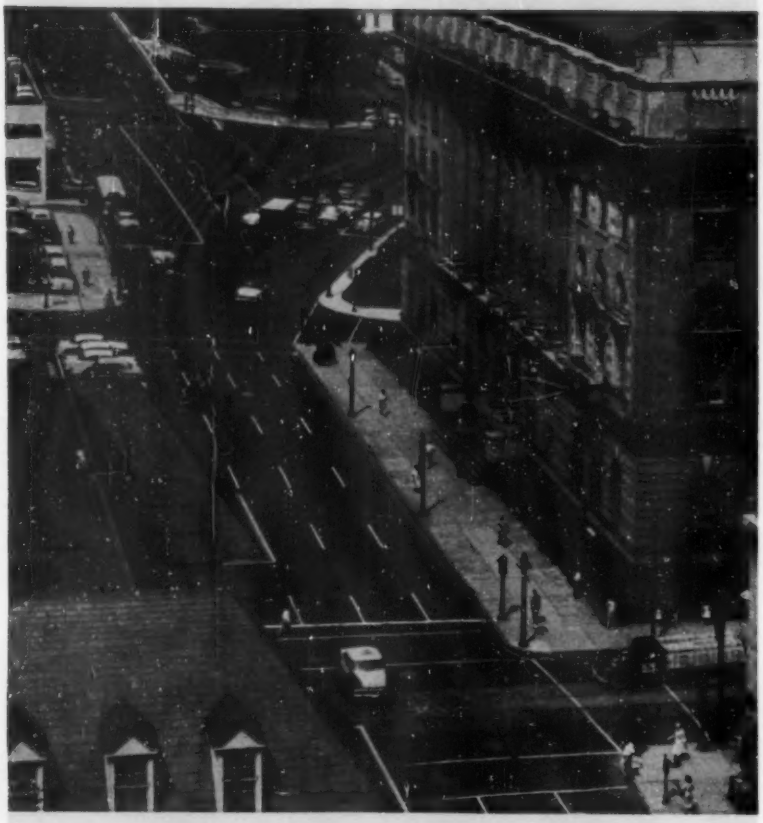
The major responsibility of the water commissioner is an adequate supply of pure water. He knows that one of the best ways to safeguard an adequate water supply is to eliminate waste and to get a full return for water delivered.

American Meters insure full revenue, because they register accurately — even trickle flows. The secret of this accuracy is the design of the measuring disc to form a more efficient seal . . . another example of American advanced engineering. That's why so many Water Commissioners everywhere buy American!

BUFFALO METER CO.

2920 Main Street • Buffalo 14, New York

SEE PERMA-LINE



IN BALTIMORE

WHY *YOU* SHOULD BE USING PERMA-LINE TOO:

PERMA-LINE is a new thermoplastic traffic marking material. You can see it *now* on the busiest streets of the nation's busiest cities: Baltimore, New York, Chicago, Atlanta, Miami Beach, Los Angeles. You will *continue* to see PERMA-LINE because it is guaranteed to outlast older marking methods 6-8 times. Now, your roads and streets can have low-cost, full-time safety protection.

PERMA-LINE applies and dries with incredible ease and rapidity. It increases in brilliance with use and forms a permanent bond with the pavement surface. There are no traffic snarls, no frequent repainting schedules with guaranteed PERMA-LINE.

PERMA-LINE alone is the professional marking tool for your professional safety program.

perma-line

VEON CHEMICAL CORPORATION • 22-09 BRIDGE PLAZA NORTH • LONG ISLAND CITY 1, N.Y.

For free illustrated brochure and the name of your nearest distributor fill in this coupon.

NAME _____ TITLE _____

ADDRESS _____

CITY _____ STATE _____

LEADER
IN
PUBLIC WORKS

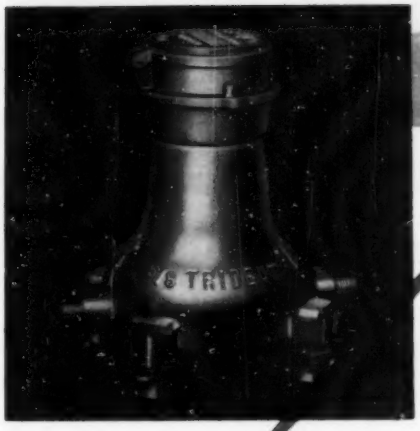
F. N. Hveem, Materials and Research Engineer, California Division of Highways, directs all materials control and research activities for the Division. The front cover picture shows him holding the plastic tube used in the sand equivalent test, with the mechanical shaker in the background. He is the author of the article in this issue on "Designing Bases for Roads and Streets."

Starting with the Division of Highways forty years ago, Mr. Hveem worked on construction, as maintenance superintendent, as resident engineer and as construction engineer for the Division. Since 1951 he has been Materials and Research Engineer. He is a member of many technical associations including Highway Research Board, ASTM, AASHO, ACI, Triaxial Institute, Ass'n of Asphalt Paving Technologists and the ASCE. He is the author of many papers and articles and the inventor of the Hveem Stabilometer, the Cohesiometer and the Mechanical Kneading Compactor. About 80 percent of the work of the Research and Materials Department involves inspection, testing, field borings, geological surveys, etc.; about 20 percent is research and development.

Mr. and Mrs. Hveem have a son in the USAF, now a Major; a daughter who is the wife of a Colonel, stationed in Washington; and two daughters at home; also five grandchildren. Hobbies are hi-fi music reproduction, home work shop, books and old automobiles.

TRIDENT METERS

EARN MORE



...COST LESS

It takes money to maintain the water supply your community expects. It's vitally important to make sure all the water pumped is paid for . . . by using accurate meters . . . and by keeping these meters in good repair.

Trident meters are built to hold accuracy longer, so you receive all the revenue you should. They're built to be easier to repair, so your shop time and expenses are cut down. They're designed so that the newest parts fit the oldest meters . . . simplifying your repair parts problem, helping you to get accurate, thoroughly modern performance from your oldest meters.

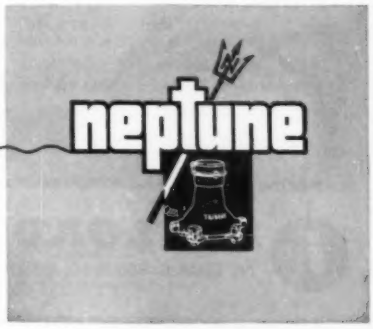
For more than 50 years, Neptune has built fine meters designed to earn more and cost less. Many 50-year-old Tridents are still in service . . . perhaps in your own community . . . living proof that the Tridents you buy today will be a credit to your water system for many long years to come.

277

NEPTUNE METER COMPANY
19 West 50th Street • New York 20, N. Y.

NEPTUNE METERS, LTD.
1430 Lakeshore Road • Toronto 14, Ontario

Branch Offices in Principal American and Canadian Cities.



Only **PAYLOADER**® can give you

as a Side Boom . . .

. . . this new SUPERIOR-HOUGH boom attachment further increases the all-around usefulness of a "PAYLOADER" tractor-shovel. A Hough exclusive on rubber-tired units, it *adds* a handy lift-and-carry facility, lets the "PAYLOADER" alternate between boom and bucket work at any time.

You can load, unload and string pipe, carry girders and sheet steel, handle piles and poles . . . or, dig and backfill dirt, load dump trucks, charge hoppers and the like — all without any time loss to change attachments.

Available for the big model HO "PAYLOADER", this side boom has 6000 lb. capacity, its 10 ft. length can be telescoped to 16 ft. maximum. This, combined with the sturdy 4-wheel-drive tractor-shovel performance, provides an economical one-machine answer to many construction and maintenance problems.

Big rubber tires permit working on pavement, over sidewalks and curbs without damage; 4-wheel-drive tractive power qualifies it for cross-country work as well.

PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

1-B-1 A

as a Spreader . . .

. . . another new and exclusive attachment that multiplies the work-ability of "PAYLOADER" tractor-shovels. Substitute this Ram Spreader attachment for the bucket and you have an economical unit that lays down 8-ft. wide strips of hot or cold mix asphalt in a single pass.

You can use it to place new pavement, to do resurfacing or patch work on streets, driveways, alleys, sidewalks, playgrounds, parking lots. Attached to the maneuverable "PAYLOADER", the machine can work in close quarters where pavers and trucks can't operate.

Spreader features include a 2-cu. yd. capacity hopper that is independently suspended on four pneumatic tires. A separate air cooled gas engine provides pressure for the hydraulic motor drive of the twin 8" diameter augers and for all hydraulic control cylinders.

Operator has convenient control levers to adjust main feed gate, thickness and width. Sliding type gates adjust for widths to 48 in.; gates are removed for 8-ft. width. See your nearby "PAYLOADER" distributor for complete details.

PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

1-B-1 B

this Versatility, Speed and Economy

as a 4-in-1 . . .

. . . a "PAYLOADER" handles many jobs other wheeled tractor-shovels can't touch. Equipped with a DROTT "4-in-1" bucket, it combines shovel, clamshell, scraper and bulldozer action in a single tool.

The "4-in-1" actually gives you the utility performance of four machines *plus* the mobile speed and tractive power of a 4-wheel-drive tractor-shovel. "PAYLOADER" is the only rubber-tired tractor-shovel available with this patented "4-in-1" bucket.

This combination of rubber-tired tractor mobility and bucket versatility provides complete on-job flexibility. You can dig, carry and dump (shovel) . . . pick-up, grasp and handle (clamshell) . . . scrape, strip, grade and spread (scraper) . . . backfill, clear and doze (bulldozer).

Reliable 4-wheel-drive "PAYLOADER" performance is assured by power-transfer differentials, "no-stop" power-shift transmission and torque converter, planetary final drives, power-steering and power-brakes plus exclusive 40° tip-back at ground level.

PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

1-B-1 C

as a Back Hoe . . .

. . . the "PAYLOADER" becomes a mobile trenching unit. With a quick interchange of bucket and hydraulically operated Wain-Roy hoe attachment it can work in a 190° radius, dig to 12' depth to install service connections, foundations, bell-holes and footings easily and economically. It can dig and dump at any angle up to 95°, right or left—a valuable feature in close quarters and heavy traffic areas.

The unit operates with only four control levers. Twin hydraulic cylinders provide a powerful digging and break-out force. Self-leveling hydraulic stabilizers relieve the tractor of undue strains. The extra work capacity you get with this back-hoe attachment at a nominal investment is worthwhile.

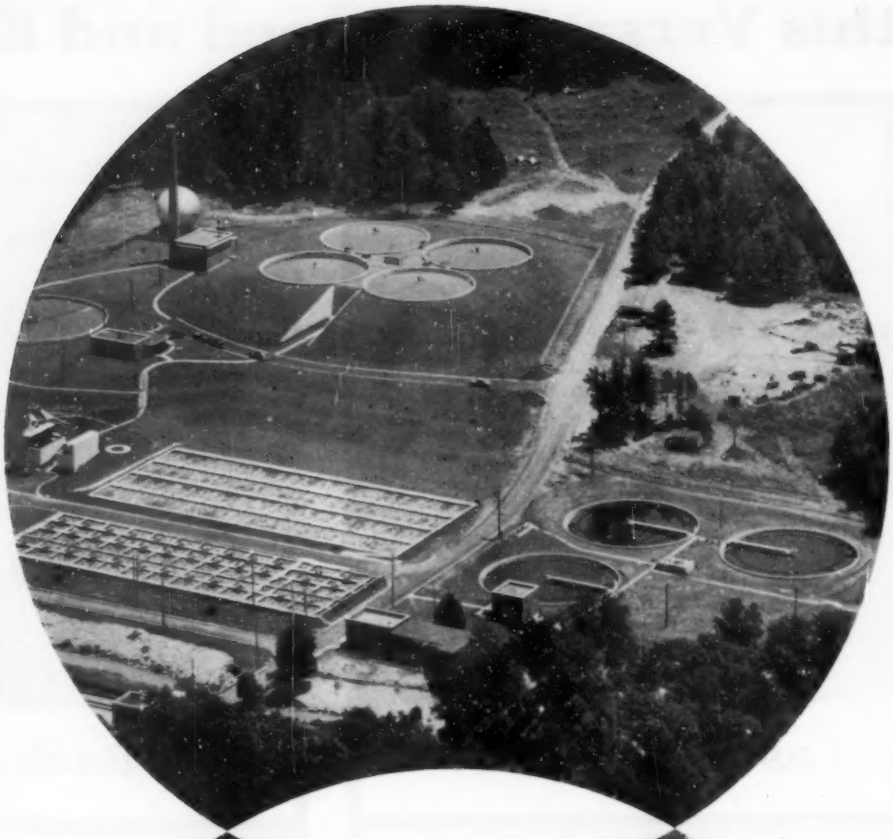
For Your Convenience . . .

PURCHASE AND HOUGH LEASE PLANS

Now your Hough Distributor has at his disposal the broadest and most complete set of financing plans ever offered: — TIME PAYMENT . . . LEASING PLANS,* with or without OPTION TO PURCHASE — any and all kinds of financing to best fit your needs for the purchase of "PAYLOADER" equipment. See him today!

* (Available in Continental U.S.A.)

1-B-1 D



DOUBLE BARRELED BENEFITS

at Charlotte, N. Car.
with TFFI specification
vitrified clay
underdrain blocks
for sewage plants

TFFI TRICKLING FILTER

Major Equipment by:
Process Engineers, Inc.,
Pacific Flush Tank Co.,
Link-Belt Co.,
Fairbanks Morse & Co.,
Chicago Pump Co.,
Marlow Pumps Division,
Bell and Gossett.

General contractors.
Rea Construction Co.,
Charlotte, N.C.

Originally designed by:
Wm. M. Piatt,
Consulting Engineer,
Durham, N.C.

FLEXIBILITY PLUS ADAPTABILITY

Trickling Filters at Charlotte sewage treatment plants were designed to treat combined domestic and industrial wastes. This called for flexibility and adaptability, and *they* called for trickling filters.

Much of the success of these filters, in turn, has been due to the selection by the engineers of **VITRIFIED CLAY** underdrain blocks of standard **TFFI** design and manufacture.

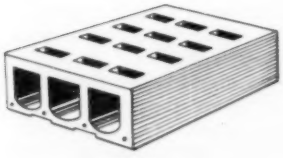
The combination of flexibility and adaptability inherent in the Charlotte filters means that they can handle easily many kinds of industrial wastes, separately or mixed with municipal sewage. The essentials are the same for low or high rate filters, for large volume or for small. *Your* requirements can be met within all reasonable limits by the same basic, properly built structure.

Other Advantages of Trickling Filters

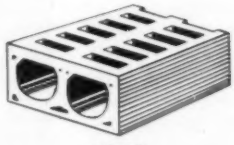
- Low first cost and operating costs
- Simple easy operation
- Long life—longer than that of the bonds issued to pay for the plant
- Overload is no problem. Take temporary and shock loads in stride
- Good results: top-notch effluent, day in and day out.

Bear in Mind These Further Important Points

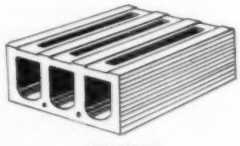
Vitrified clay TFFI specification blocks for trickling filter underdrain systems have advantages which designing engineers can count on. They are (1) Infinite length of life inherent in the clay. (2) Resistance to acids, alkalis or other potentially harmful components. (3) Manufacture in an adequate plant under controlled conditions and in compliance with strict specifications. (4) Low cost. (5) Tearing out a filter bottom later to replace blocks of any other material is too costly to be risked.



DICKEY
W. S. Dickey Clay Mfg. Co.
Kansas City 6, Mo.

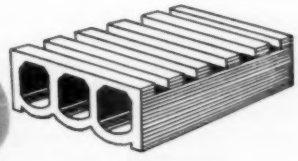


BOSCO
Bowerston Shale Co.
Bowerston, Ohio

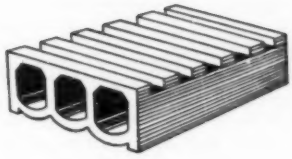


POMONA
Pomona Terra-Cotta Co.
Pomona, No. Car.

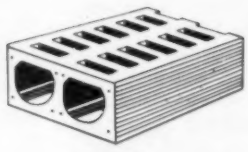
FLOOR INSTITUTE



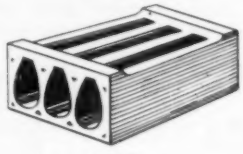
TRANSLOT
Texas Vitrified Pipe Co.
Mineral Wells, Texas



TRANSLOT
Cannelton Sewer Pipe Co.
Cannelton, Ind.



ARMCRE
Ayer-McCarel Clay Co., Inc.
Brazil, Ind.



NATCO
Natco Corporation
Pittsburgh 22, Pa.

Bag Your Trash with a *"Litter Shark"*

Tarco's rugged "Litter Shark" takes the Stop, Stoop and Touch out of litter pick-up. Challenges your men to Faster, Neater work . . . with less fatigue. Adds dignity to a routine, distasteful job. Safe, Sanitary, and most Economical.

in Gutters: Curb-Close

The "Litter Shark" sucks up: beer cans, loose newspapers, milk cartons, pop corn boxes, paper cups and plates, serving trays, programs, ticket stubs, cigarette stubs, straws, grass clippings, leaves. Use the "Litter Shark" in your Street Gutters; on your Sidewalks; in your Picnic and Parking areas; at your Recreation and Amusement spots. Use it on any surface: smooth and hard; loose gravel or stone cover; grassy turf.

Construction: Powerful vertical-shaft gasoline engine with recoil starter. All-steel direct connected suction impeller. Welded steel suction case with replaceable stainless steel liner. All steel suction shroud, 30" wide, heavily reinforced. Broad-tread, rubber tired wheels. Large heavy litter bags. Special bag-support rack. Short, single-turn, direct litter travel within suction case assures no-clogging operation.

Write for details and nearest dealer location

TARRANT Mfg. Co.
28 Jumel Place
Saratoga Springs, N. Y.

DESIGN OF DRIVEWAYS

I was interested in your article about the design of entrance driveways on the Editor's Page of the October issue.

It seems that each year we receive an increasing number of complaints of tail pipes or bumpers dragging on entrance driveways. It would seem to me that the answer would be to make a concerted appeal to the automobile manufacturers to take this factor into consideration more seriously. In a great many instances, due to the contour of the ground, it is difficult to build a driveway which will not cause trouble, if they continue to hang metal further out and lower beyond the wheels. I should like to see you start something along this line.

Neal Bartholomew
Director, Public Works & Utilities
Eau Claire, Wisc.

SOLVING PROBLEMS OF SUBDIVISIONS

I thought you would be interested in some reactions to the Subdivision article which was published in the November, 1957, issue of PUBLIC WORKS. Enclosed are copies of letters from A. B. Uzzle, City Manager of Dunn, N. C.; John L. McBride of East Bay Municipal District; and Richard Gallagher, Director of Public Works, San Diego, Calif. These letters result because the subject happened to be one that concerned different people over wide areas of the country. I thought you would be interested in them. We have had requests for more copies of the November issue and if you have any to spare, we will be happy to have them.

Victor W. Sauer
Public Works Director
Contra Costa County
Martinez, Calif.

Ed. Note: We also have received favorable comments on Mr. Sauer's article. See also the next letter.

REFUNDS DUE BUT NO FUNDS TO RE

The article on subdivisions in your November issue (by Vic Sauer) was of great interest to me as we are in the midst of trying to write an ordinance on extension of facilities. The City has always extended anything for anybody and when money was short the developer paid for the extension with a refund agreement. Now we are coming up to the refunds and sometimes no funds to re. The methods of other cities would be of interest.

Roy R. Robinson
City Manager
Kinston, N. C.

HOW MANY MANHOLES?

Thank you for the information on probable annual manhole cover installation and replacement. I have assumed a life of fifty years and have come up with a figure of 100,000 manhole covers installed in 1907 and replaced in 1957. To this I have added your estimate of 187,500 new manholes installed per year. My own estimate was a more modest 162,000 and the grand average of all estimates I have is about 400,000 per year.

W. W. Taylor,
Silent Knight Co.
Cincinnati, Ohio

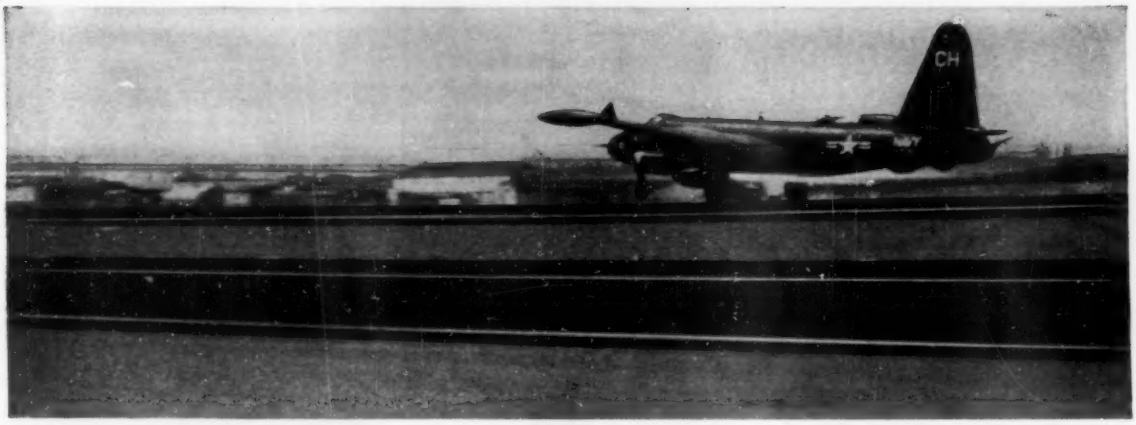
Estimates and/or data on manhole construction and replacement will be received with interest—The Editors

FILTERS AND MICROSTRAINERS

We would like to call your attention to an article in your September issue headed "Diatomaceous Filters and Microstrainers", and to take the opportunity of bringing up to date the information therein.

1) The summary stated that "Microstrainers were reported in 1956 to be in operation or in the course of construction in nearly 60 plants in England". Our plants in operation or under construction, all over the world, number more than 90 and of these one is in operation in the USA at Bonner, Montana, for the Anaconda Company, and three are under construction in Canada.

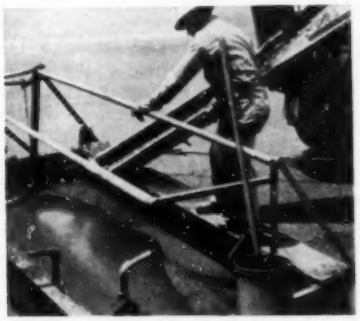
2) Reference is only made to the employment of our equipment ahead of slow sand filters. Microstraining has manifold uses. In summary, 21 installations are ahead of slow sand filters and 19 ahead of rapid sand fi ters; in 40 installations microstrainers provide the sole filtration, 23 in public and 17 in industrial plants; 9 installations treat sewage or industrial wastes; and 4 others are



Navy gets double savings with Bitumuls Slurry Sealing of Runways at Jet Training Station

ONE of the busiest military air installations on the entire West Coast is the Alameda Naval Air Station. In addition to heavy traffic in propeller-driven aircraft, Alameda is an important West Coast jet aircraft training center.

Runway Construction—The runways of this Naval Air Station are surfaced with asphaltic concrete, placed over a 6" course of Bitumuls Sand Mix. The wide shoulders adjacent to these runways are also Bitumuls RS-1 Chip Seal. The surfacing was placed some four years ago, and recently showed signs of weathering. Close



Bitumuls Slurry is chuted into spreader-box as mix-truck travels at speeds up to 5 MPH.

inspection disclosed some ravelling; minor hair-cracks on the surface; and some loose material. This loose material, while of little importance during the days of conventional-type aircraft, had become a major source of expense after jets started operating here. Sand, small stones, and other loose material can cause considerable damage, when scooped into the jet engines.

A Dual Problem—The Navy was looking for answers to two problems: First, a method of revitalizing the runways and extending the life of the pavement surface. Second, a means of cutting down the repair bills involved when jet engines were damaged by loose material scooped up from the surface of the runways. *They found a single answer to both these problems in Bitumuls Slurry Seal!*

Bitumuls Slurry Seal composed of fine, sharp aggregate, Bitumuls Mixing Grade emulsified asphalt and water, was mixed in transit-mix trucks to a free-flowing, slurry consistency. It was applied by the squeegee action of a spreader-box to 350,000 sq. yards of runway and taxi-way. Contract for this work was awarded to George Reed, a contractor from Modesto, California.

To offset the high abrasive action of the aircraft tires on landing, a dilute (3 to 1) Bitumuls tack coat was placed ahead of the Slurry Seal to insure maximum adhesion.

Fast-Fast Application—It was "business-as-usual" at the Air Station while this work was in progress. In spite of the additional requirement of the tack coat, Bitumuls Slurry Sealing reduced interference with air traffic to a minimum. Planes at the Station were able to taxi over the fresh seal coat four hours after application. Jet aircraft landed on the new seal 24 hours after application.

The costs involved in providing this new life for the existing runway pavement was considerably less than that of a normal seal coat application.

"Meanwhile, at the Hangar..." In the repair shops, an extra "bonus" economy will be realized because Bitumuls Slurry Seal has eliminated loose material from the runways. *The cost of mechanical repairs occasioned by the induction of foreign material through the jet engines is expected to be sharply reduced.*

A Proved Procedure—Bitumuls® Slurry Seal has been proved on many installations—on highways, streets and airport runways—in terms of economy of initial application, and also in terms of durability. It can be applied in any quantity or volume for either construction or maintenance. Call our nearest office if you need additional information. It will be given gladly: and, of course, without obligation.

American Bitumuls & Asphalt Company

320 Market St., San Francisco 20, California

Baltimore 3, Md. · Mobile, Ala. · Inglewood, Calif. · St. Louis 17, Mo. · San Juan 23, P.R. · Oakland 1, Calif. · Perth Amboy, N.J. · Cincinnati 38, Ohio · Tucson, Ariz. · Portland 8, Ore.

Cut Steel or Cast Iron Pipe up to 12"
EASIER and FASTER
WITH THE NEW
REED

HINGED 4-WHEEL
PIPE CUTTER

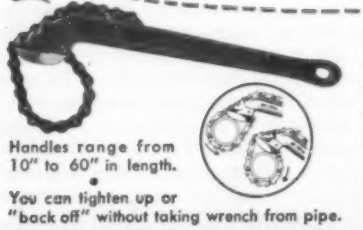
- Closed Frame Construction assures complete rigidity with less weight.
- 4-Wheel design needs minimum swing of handle.
- 4-Point pipe guide aligns cutter for perfect tracking of wheels and a right angle cut.
- Quickly interchangeable wheels for steel or cast iron.
- Needs only 3" space to pass under 12" pipe.

For ditch work or similar close-quarter operations these new Reed Cutters are practically indispensable and fully justify replacing whatever cutting equipment you are now using.

You can, for example, cut 8" steel pipe in less than five minutes, and cast iron pipe even faster.

Available in five sizes for steel or cast iron pipe from 1" to 12".

FOR FAST TURNING IN TIGHT SPOTS—
USE THE IMPROVED REED CHAIN WRENCH



Handles range from 10" to 60" in length.

You can tighten up or "back off" without taking wrench from pipe.

These improved chain wrenches will do anything an ordinary pipe wrench will do... and do it easier, better and faster. Ideal for ditches or tight corners.

Grip securely with no play, yet they have a ratchet-like action.

REED
Unconditionally guaranteed to do the most efficient tools you have ever used. See your jobber or write for literature.
REED MANUFACTURING COMPANY
ERIE • PENNSYLVANIA

utilized in miscellaneous applications.

G. R. Evans
Vice President
Glenfield & Kennedy, Inc.
New Rochelle, New York

PAYMENTS FOR STORM SEWERS

This refers to the letter from E. L. Miller which appeared in November PUBLIC WORKS.

The policy established by the City Commission of Buchanan provides that storm sewers shall be paid for by the property owners proportionately for all sewers 12-in. in size or less. The City absorbs all costs for trunk lines in excess of this size.

One exception to this proportionate share is when the property is located on the corner of the block. In this case, the property owner pays 100 percent of the footage cost across the frontage and 25 percent of the footage cost along the side street. The City assumes the remaining 75 percent of the side street cost.

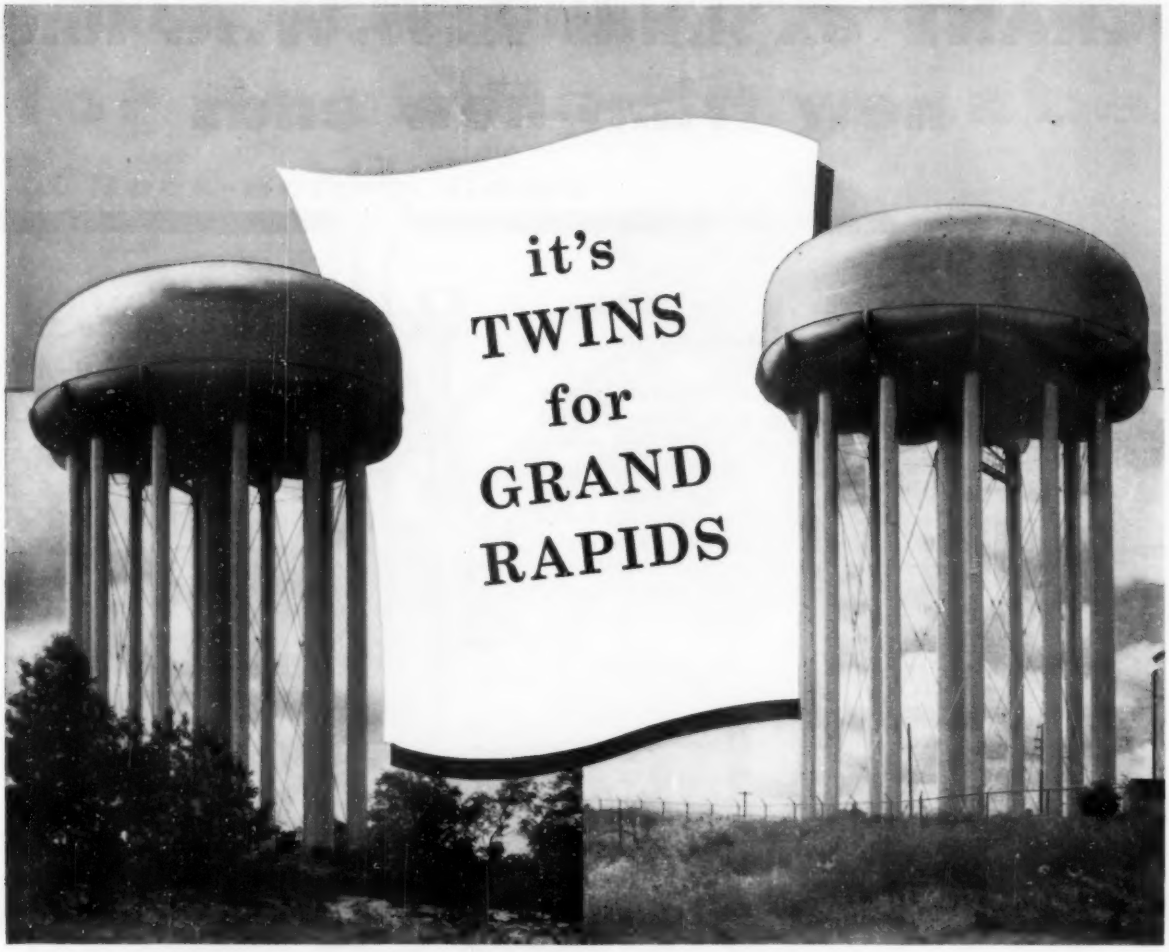
This method of spreading assessments is the same for curb and gutter which is also required when storm sewers are provided.

John H. Kennaugh
City Manager
Buchanan, Mich.

REPAIRING SERVICES WITH DRY ICE

Sometime ago Victor Smith, Supt. of Public Works and Utilities, Fenton, Mich., wrote us for information regarding freezing of 6-in. hydrant stubs to facilitate replacing valveless hydrants. We sent him the information. Now he forwards, for the benefit of others, the following from December's "The Meter Setter" of the Ford Meter Box Co., Wabash, Ind.: "Some ten years ago we did some experimental work on the use of dry ice for quick freezing of pipes to prevent water flow and permit repairs or extensions to service lines. We prepared an article which was published in some of the water works magazines and made demonstrations at several water works meetings to show how a tight ice plug could be formed in two minutes.

"The process is in successful use in many places and some water works men have extended it up to 6-in. mains. We have reprints of articles giving pictures and detailed instructions which we shall be glad to send on request (to Ford Meter Box Co.)."



Two 1,250,000-gal. Horton Radial-Cone Tanks provide modern water storage

It's identical twins for the city fathers of growing Grand Rapids, Michigan!

These two Horton® radial-cone bottom elevated tanks provide 2,500,000 gallons additional water storage capacity and provide dependable gravity pressure to meet peak load periods in suburban Grand Rapids. The two tanks stand 95 feet to the bottom and have a 30 ft. range in head.

By reducing the load on a community's overworked pumping, treating and transmission facilities, Horton elevated tanks improve distribution pressures, provide emergency reserves, improve insurance ratings and reduce pumping costs.

Horton radial-cone bottom tanks are built in capacities to 3,000,000 gallons. Combining sound engineering with practical design they can take the "pain" out of *growing* for your community. Write our nearest office for further information.

Two identical 1,250,000-gallon Horton radial-cone bottom elevated tanks built for Grand Rapids, Michigan.

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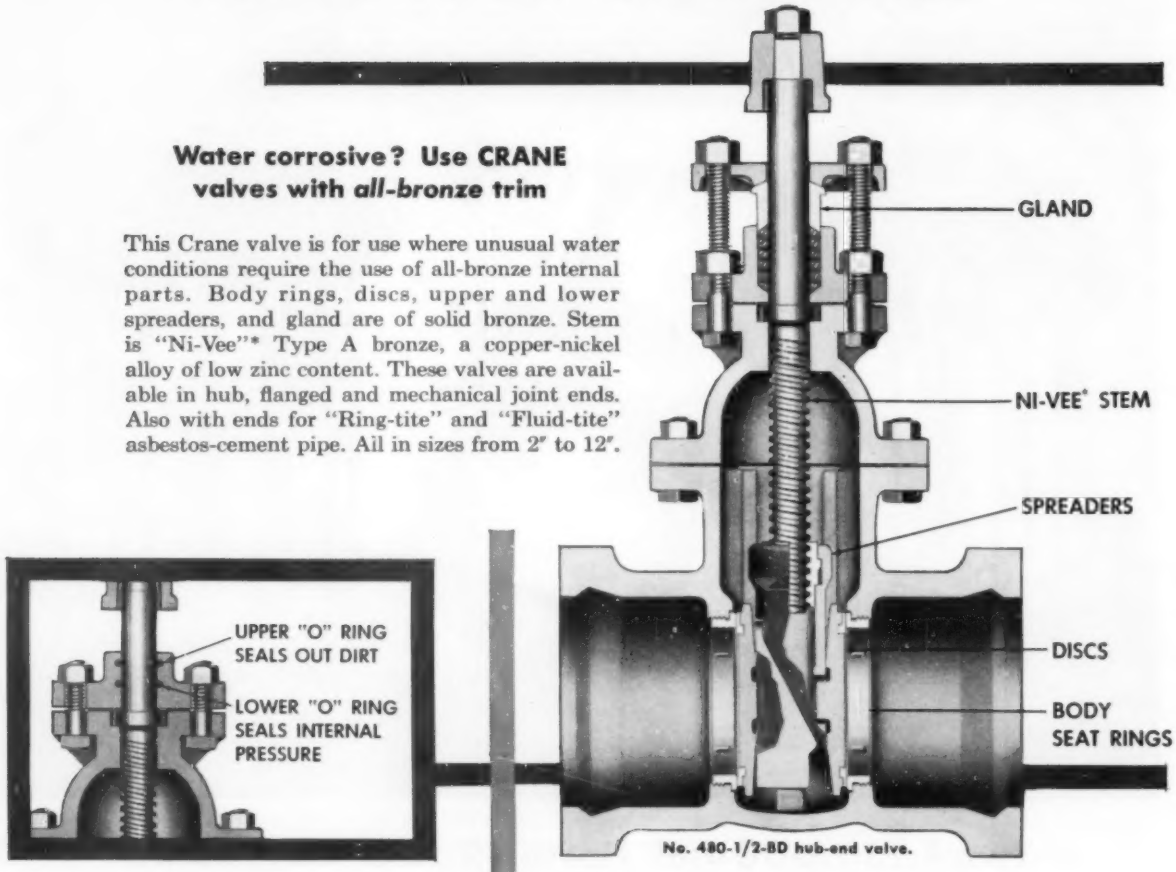
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

CRANE expands A.W.W.A. line new trim–new ends

Water corrosive? Use CRANE valves with *all-bronze* trim

This Crane valve is for use where unusual water conditions require the use of all-bronze internal parts. Body rings, discs, upper and lower spreaders, and gland are of solid bronze. Stem is "Ni-Vee"* Type A bronze, a copper-nickel alloy of low zinc content. These valves are available in hub, flanged and mechanical joint ends. Also with ends for "Ring-tite" and "Fluid-tite" asbestos-cement pipe. All in sizes from 2″ to 12″.



No. 480-1/2-BD hub-end valve.

Double "O" ring stuffing box now available

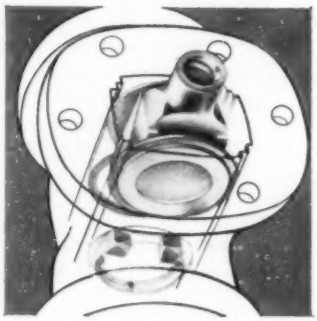
Another feature now available in Crane A.W.W.A. non-rising stem valves is an "O" ring stuffing box. Two Buna-N "O" ring seals hug the stem tightly. Lower ring acts to seal the internal pressure; upper ring is an external dirt seal and reserve pressure seal. Valves with "O" ring stuffing boxes are available with hub, flanged, mechanical joint ends—in all sizes from 2″ to 12″.

*"Ni-Vee" is the registered trade-mark of International Nickel Co.

Features of CRANE A.W.W.A. Valves justify their choice

Simple, 4-part double-disc assembly—2 discs, 2 spreaders. Discs are free to rotate—minimizing concentrated seat wear. Discs cannot fall out or jam. Easy opening and tight closing assured. Valves have much longer service life.

For complete details on these valves, write for circular AD-2108.



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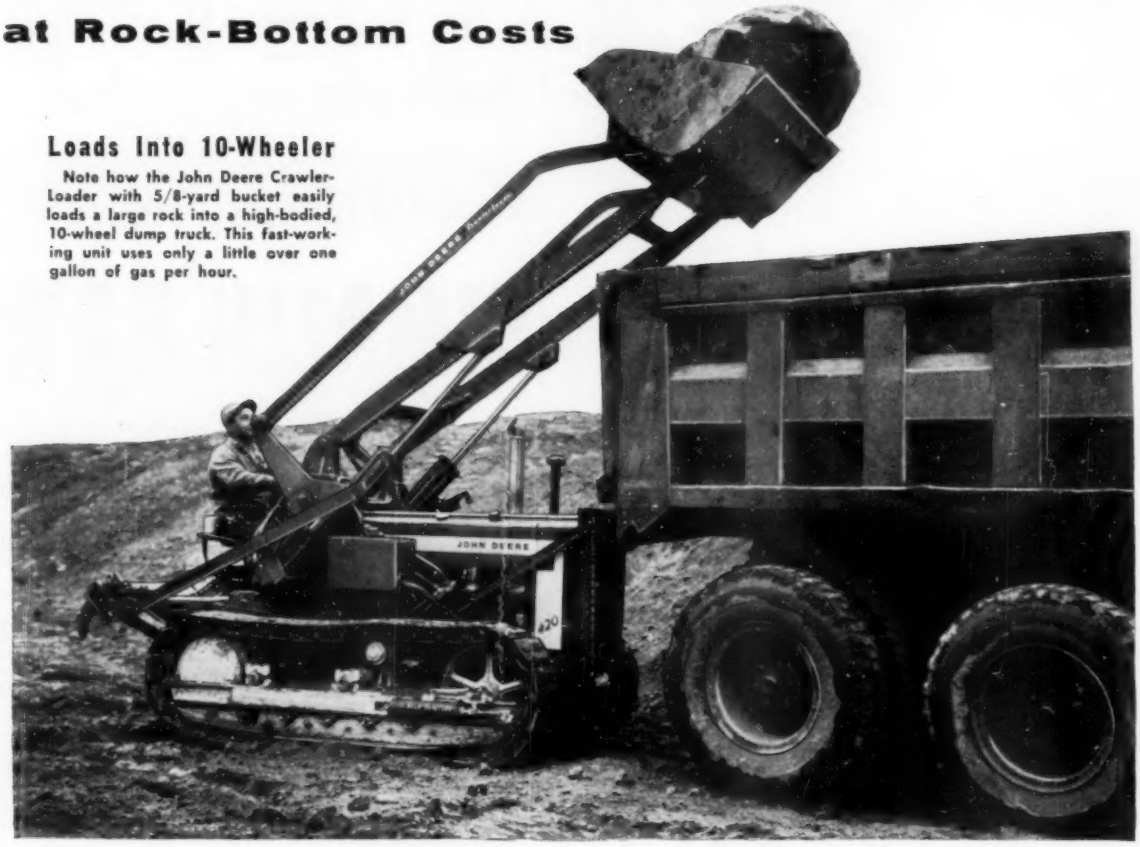
JOHN DEERE CRAWLER-LOADER

for Peak Performance

at Rock-Bottom Costs



Loads Into 10-Wheeler

Note how the John Deere Crawler-Loader with 5/8-yard bucket easily loads a large rock into a high-bodied, 10-wheel dump truck. This fast-working unit uses only a little over one gallon of gas per hour.

MATCH the work output of larger tractors on many jobs . . . hold down your costs all the way . . . with the John Deere "420" Crawler-Loader—a versatile, high-quality unit that you'll find mighty profitable to own.

Amazing power for its size . . . compact design . . . clutch-brake steering . . . and the fast, handy direction reverser are some of the many features that put the John Deere in a class by itself for speedy, low-cost maneuverability and daily work output.

Seeing is believing! Get in touch with your nearest John Deere Industrial Dealer.

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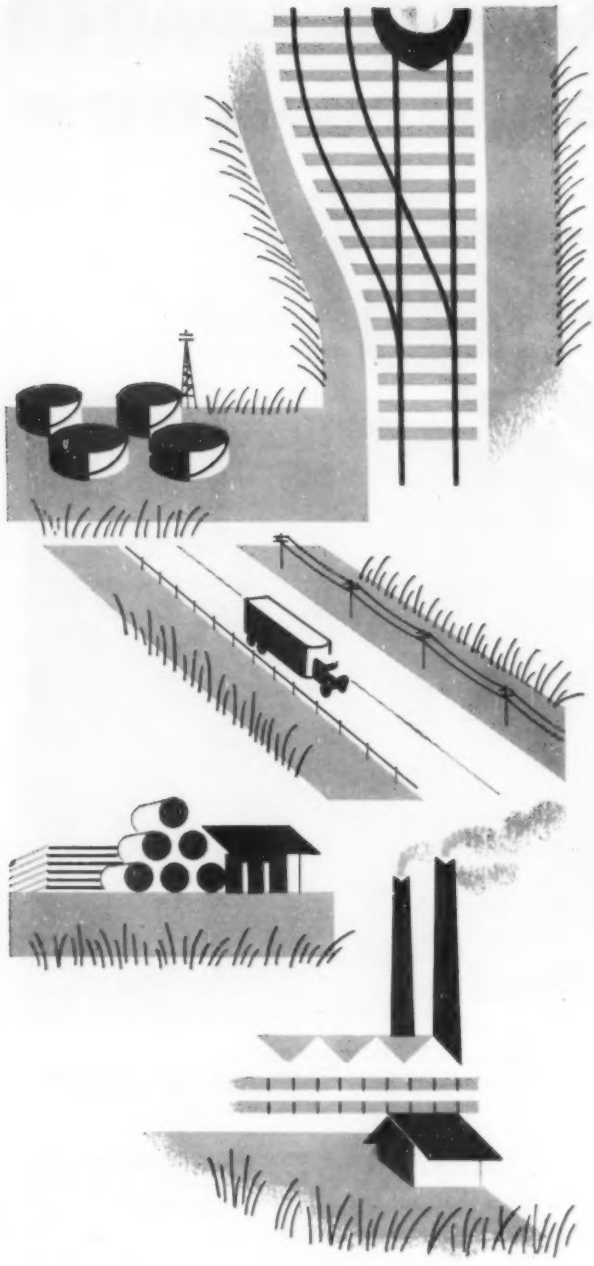

announcing . . .

Geigy

SIMAZIN* 50W

a new pre-emergence herbicide

Now available for long residual control of grassy and broadleaf weeds in driveways, roadways, railroads, walks, paths, industrial sites, around buildings and other non-cropped areas.

NOW YOU CAN STOP WEEDS BEFORE THEY START with Geigy's amazing new pre-emergence herbicide Simazin 50W. Think what *preventive* weed control with Simazin 50W can mean in terms of time and money saved for industries, municipalities, highway commissions, railroads, utilities and any other business or service concerned with the problem of weed control on non-cropped areas.

How Simazin 50W Acts

Simazin 50W, a triazine compound, is not a contact or foliage herbicide, but acts on the plant roots, and should be applied just before germination or emergence for best results. Before using Simazin 50W for long residual weed control, existing plant growth should first be removed by use of a contact herbicide, or by mowing or ploughing under.

Long-Residual, Economical

One pre-emergence application of Simazin 50W applied at the rate of 10 lbs. per acre controls most grassy and broadleaf weeds for about a year. The material is economical and easy to use. At the maximum rate of application, less than ½ lb. is required to treat 1,000 sq. ft.

Controls a Variety of Weeds

Simazin 50W controls a wide variety of grasses and broadleaf weeds including barnyard grass, witch grass, yellow foxtail, wild oats, crabgrass, broadleaf plantain, dandelion, lamb's quarters, pigweed, ragweed, nightshade, purslane, velvetleaf and mustard.

Low Toxicity, Non-Corrosive

Simazin 50W has very low toxicity to humans and domestic animals. It is non-corrosive and can be removed from spraying equipment by merely flushing thoroughly with water.

No Lateral Leaching

Since there is practically no lateral leaching, Simazin 50W can be used adjacent to crop land and ornamental areas. Lack of phytotoxicity to foliage minimizes drift hazard.

Availability

Geigy Simazin 50W, containing 50% active ingredient is available in cases of 10 x 5 lb. bags and 50 lb. fiber drums.

Free Technical Bulletin

Send for your free copy of the Simazin Technical Bulletin and descriptive pamphlet. Address Department **PW-87**

*"SIMAZIN" is a trademark of Geigy Chemical Corporation

ORIGINATORS OF Geigy DDT INSECTICIDES

GEIGY AGRICULTURAL CHEMICALS • *Division of Geigy Chemical Corporation* • **Saw Mill River Rd., Ardsley, New York**

AMERICAN Fastite® JOINT* CAST IRON PIPE

Now—another important AMERICAN development—a superior *double-sealing* gasket type joint—American Fastite! This new *field-tested* joint brings installation time and labor costs to new lows! The exclusive *double-sealing*, dual-density rubber gasket and the scientifically designed gasket recesses permit faster, more simple installation—allow liberal deflections—provide positive sealing under low or high pressures! Get full information about the American Fastite joint today—discover for yourself the advantages available only with American Fastite Joint* Cast Iron Pipe.

EXCLUSIVE DOUBLE-SEALING, DUAL-DENSITY RUBBER GASKET!

- Hard rubber end provides a strong shoulder for self-centering and locking—a permanent seal against cold flow under pressure, fully protected against deterioration.
- Softer large end for positive compression, liquid-tight sealing and easy assembly.

Tests prove either hard or soft rubber section **alone** provides a positive seal.

Ask your American Cast Iron Pipe Company representative about the unique advantages of this superior **double-sealing** single gasket joint—American Fastite—or write today for a free descriptive brochure.

**Patent applied for—Underwriters Laboratories, Inc. approved.*

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LEGAL ASPECTS OF PUBLIC WORKS

MELVIN NORD, Dr. Eng. Sci., LL.B.

An Explosive Case

Hersum v. Kennebec Water District, 151 Me. 256, 117 Atl. (2d) 334, a Maine case decided Oct. 19, 1955, was a suit for damages for personal injuries, death, medical expenses, and property damage resulting from an explosion in the basement of the plaintiff's home.

It all started on April 16, 1953, when the Kennebec Water District was laying a new water main along Dalton Street. Before starting any excavation of the street, the Water District requested the Waterville Gas Co. to furnish assistance by indicating the location of its concealed pipes. Two employees of the gas company went to Dalton Street to supply the requested information.

The plaintiff's home was on the opposite side of Dalton Street. The gas company representatives informed the Water District's employees that there was a pipe leading to two houses across the street from the Hersum house.

Donald Guerney was employed by the Water District to supply a backhoe shovel with an operator. The operator of the shovel was excavating along the line of the water main when his shovel struck an obstruction in the ground. He immediately ceased excavation and reported the fact to the Water District's foreman, who had one of his men dig around the object with a hand shovel. It was found to be a pipe running across the trench. The foreman entered the trench, examined the pipe, and observing neither the smell of gas nor the presence of water, assumed that it was an abandoned pipe.

After completing the trench, the water main was laid, and the trench was filled.

On June 27, 1953, over two months later, the plaintiff's daughter Helen entered the Hersum home early in the forenoon. Ten minutes later there occurred an extremely violent explosion in the Hersum house, which was of such proportions that the house eventually had to be razed to the ground. The neighbor, Mr. Millet, immediately ran to the scene and pulled Helen Hersum from the cellar through a large gap in the wall. She was conscious, although her hair and clothing were in flames. Mr. Millet took off his coat and smothered the flames and asked her what happened. She told him she had pulled the oil burner switch to turn on the hot water heater, when the explosion occurred. She was taken to the hospital, where she died a few days later as a result of her burns and injuries.

In the afternoon of the same day, the State Director of Fire Protection began an investigation of the site, which was completed two days later. In the course of this investigation, an "explosion meter" was employed. There was a gas service entering the Hersum house, but it had been completely shut off for a considerable period. All tests for leaking gas through or around the gas service were negative. In another part of the cellar, however, there was a hole or opening in the foundation wall on the level of the service floor where the water service pipe entered the house. Tests within this opening disclosed the presence of gas in explosive proportions. The same was found to be true under ground outside the foundation wall opposite the opening. Tracing the gas back toward the street, the indications pointed toward the line of the water service. By careful digging, the gas main was exposed, and it was found that there was a T joint entering the gas main. Gas was leaking at this joint and there was a crack or break in the thread of the feeder pipe which appeared to be fresh.

The gas supplied was a propane gas, which has no odor. A very small amount of ethyl mercaptan is mixed with the propane, to provide a warning odor. It was found that the gas had an odor at the cracked joint, but that ethyl mercaptan had been absorbed in the soil around the joint.

The court appointed a referee to determine the facts. He decided that the cause of the cracked joint was the blow given by the backhoe shovel to the gas pipe at a point across the street, where the water main trench had been excavated. He also decided that the ethyl mercaptan had been absorbed from the gas, in passing through the soil, and that was the reason why no odor of gas had been detected in the Hersum house before the explosion. The throwing of the oil burner switch ignited the explosive mixture of gas in the cellar.

The defendant claimed that these conclusions were mere surmise and conjecture, but the Maine Supreme Judicial Court held that they were amply supported by the evidence.

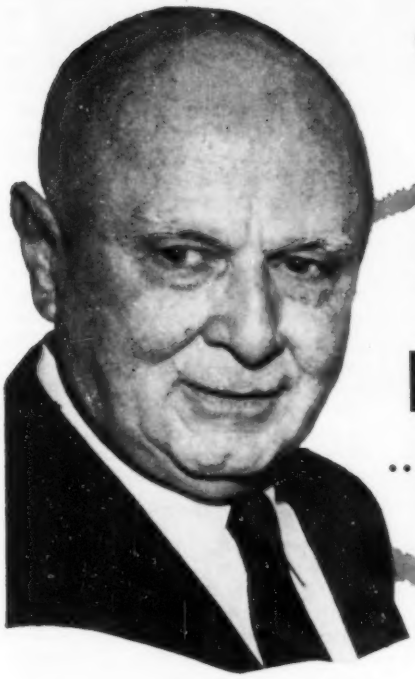
This case is annotated in 53 A.L.R. (2d) 1083, where a number of somewhat similar cases are collected.

Gravel Bids

The case of *Fodness v. City of South Sioux Falls*, 71 N.W. (2d) 618, a South Dakota case decided August 10, 1955, presents an interesting problem relating to competitive bidding in municipal contracts.

Mr. Fodness, a supplier of gravel, agreed with the street commissioner of the City of Sioux Falls to deliver gravel to any part of the City for $1.10 per yard. As an immediate need for gravel at some particular location arose, its purchase was authorized by the city commission at a regular meeting, but no record was made in the minutes of the meeting. Then the street commissioner would place an order with Mr. Fodness. A total of 74 such orders was placed with him between March 26 and Dec. 9, 1952, none of which involved more than $500. The orders aggregated $8,076.30. The gravel was not billed as it was delivered. Slips representing particular purchases or orders were attached to nineteen different statements. These statements were filed at irregular intervals. In May 1953 the city paid Fodness $500 and thereafter continued to make similar monthly payments. As each $500 payment was made, a voucher was approved at a regular meeting, and a record of the approval was made in the minutes of the meeting.

A balance of $2,076.30 remained unpaid to Fodness when the City was restrained by court order from paying the balance. The court order was granted upon a suit by taxpay-

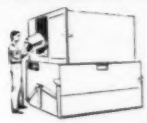


winner of $32,000 on "The $64,000 Question"

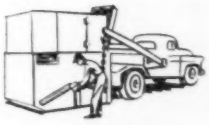
George R. Dempster Says . . .

$32,000.00 Is a Lot of Money

...but many cities save more than that every year with the Dempster Dumpster!



"Containerized" rubbish . . .



is picked up . . .

hauled . . .

and dumped

It's a fact! Your city, like hundreds of others, can save taxpayers thousands of dollars every year with our Dempster-Dumpster System of rubbish disposal. Using this low-investment System, one man and one truck-mounted Dempster-Dumpster can handle the entire bulk rubbish accumulation in the commercial district of a good-sized city. The savings are obvious . . . the improvement in city "housekeeping" is astonishing! Merchants love the big, clean Dempster-Dumpster Containers, which provide enclosed rat-proof, fly-proof, scatter-proof storage of rubbish and refuse. Don't let these savings and advantages get away — start checking your bulk waste disposal costs today.

WRITE TODAY for complete information on our two new time-payment plans.

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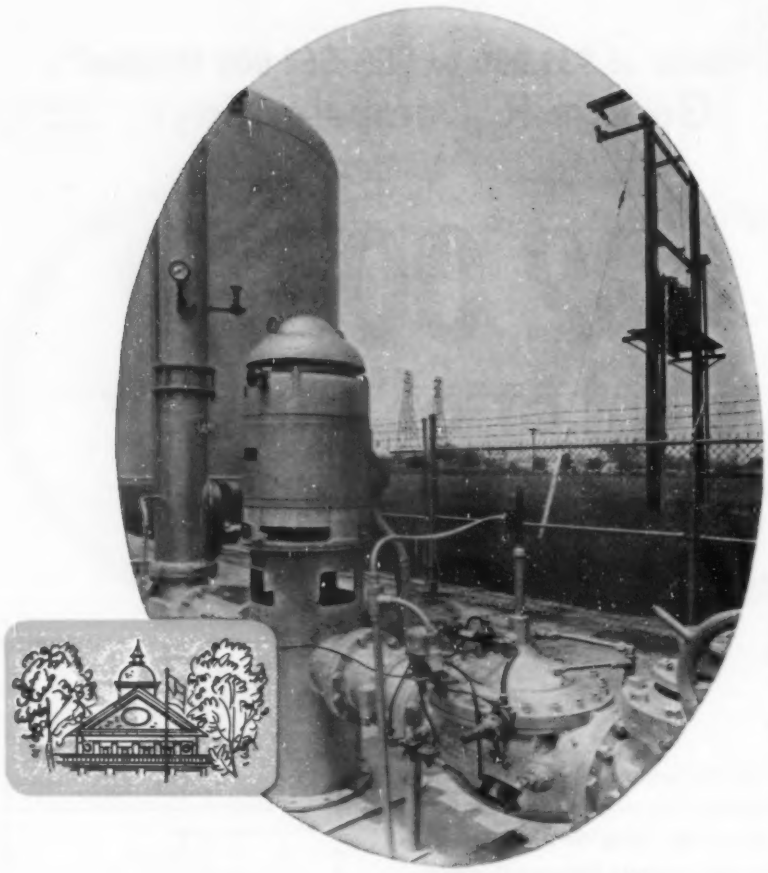

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This Suction-Cased Booster Pump is one of two Verti-Line units maintaining pressure in a large water system.

It is a 60 HP pump, handling 1,000 GPM against 170 feet head. Installed in August 1953, it has proven highly satisfactory in performance – and has cut maintenance expense to the bone.

Over 100,000 satisfied vertical pump users agree there's no pump like Verti-Line for low first cost, economical operation, and negligible maintenance.

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ers, on the ground that in the case of expenditures of $500 or more by a City, the state statute of South Dakota requires competitive bidding.

On appeal to the state Supreme Court, the restraining order was upheld, (4-1), on the basis that otherwise the entire object of the statute would be readily circumvented.

The case is annotated in 53 A.L.R. (2d) 498. A consideration of the cases in all jurisdictions indicates that whether or not such a split contract will be upheld depends on whether or not the court finds that the splitting has been done with the purpose of evading the statute. If the public officials responsible for letting the contract appear to have acted in good faith, multiple contracts may be upheld, even though the aggregate exceeds the statutory amount.

Wrongful Death Actions

Parker v. City of Jacksonville, 82 So. (2d) 131, a Florida case decided July 20, 1955, involved a wrongful death action against a municipality, which was brought by the widow of the deceased within the 2-year Statute of Limitations period for wrongful death actions, but not within the 12-month period prescribed for an action against a municipality "for any negligence or wrongful injury or damage to person or property."

The Florida Supreme Court unanimously held that the suit had not been commenced too late. In other words, it held that a "wrongful death" action, brought by the decedent's widow, is not an action for "an injury or damage to person or property."

The reason for this distinction is that, although the action undoubtedly arises out of a personal injury resulting in death, the widow's cause of action is based on the violation of "the right which the family of the deceased had to the companionship, services or support of the decedent, coupled with the expectancy of a participation in the estate which such person might have accumulated had his life not been brought to an untimely end by the infliction of the injury." This is obviously not an injury to her person. Nor is it an injury to her property, since she had no property rights in her husband. It is an injury to her family *status*. The ownership of property is one kind of legal status, but that should not make us assume that the law recognizes no *other* type of legal status.

The case is annotated in 53 A.L.R. (2d) 1068. The cases are in some conflict, although the majority view appears to agree with this case.

WANTED! Engineers who can cut costs without sacrificing quality

Who wants them? Just about every corporation, government body and engineering firm faced with today's high construction costs. Hundreds of intended projects need engineers who know how to use more efficient designs and construction methods.

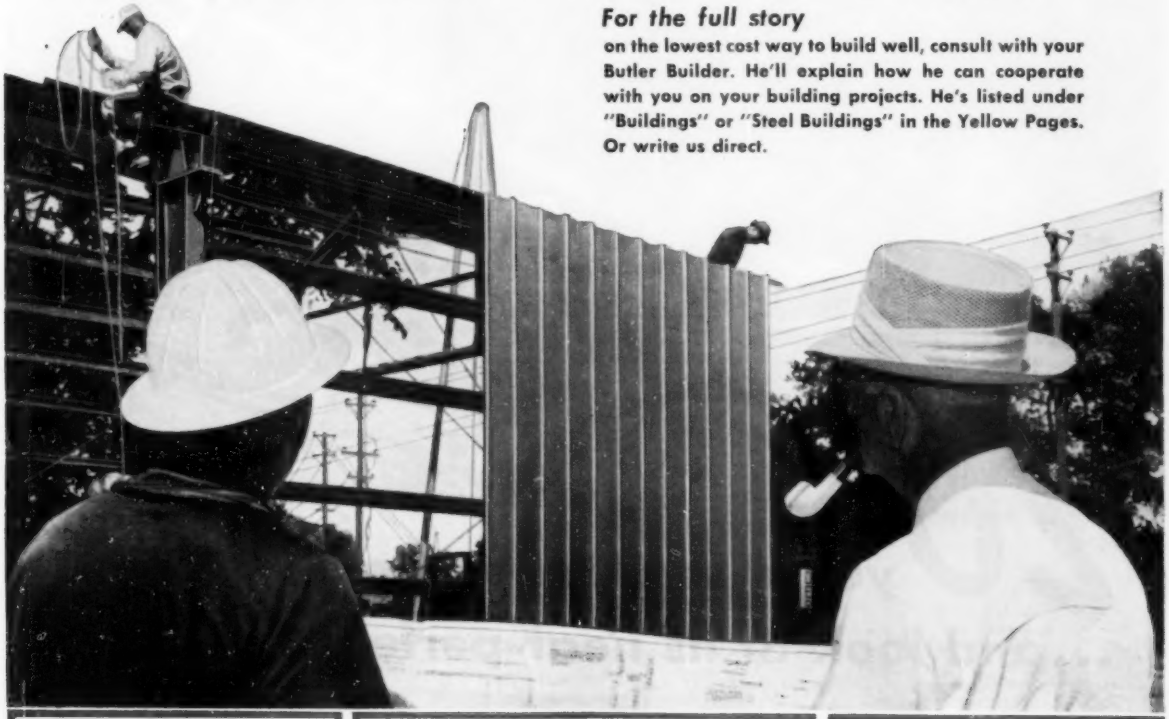
To satisfy this demand, many engineers utilize the Butler Building System for single-story construction. Butler provides a pre-engineered structural and roof system that is precision-made, mass-produced and load-tested to conform with uniform, state and municipal codes.

Assembly is fast and provides clear-span widths to 120 feet in efficient designs that are remarkably low in cost considering their quality and advantages.

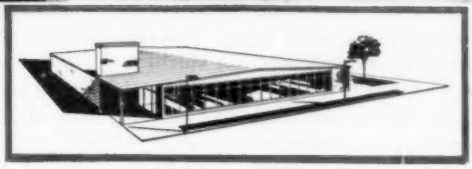
The engineer spends less time and money on routine details—is better able to maintain quality while keeping a tight control over costs—cost of the basic structure . . . cost of installing heating, lighting, cooling and ventilating units . . . and cost of exterior and interior finishing.

For the full story

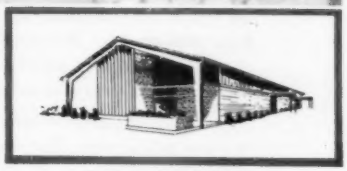
on the lowest cost way to build well, consult with your Butler Builder. He'll explain how he can cooperate with you on your building projects. He's listed under "Buildings" or "Steel Buildings" in the Yellow Pages. Or write us direct.



All-metal Butler



New low-profile Butler



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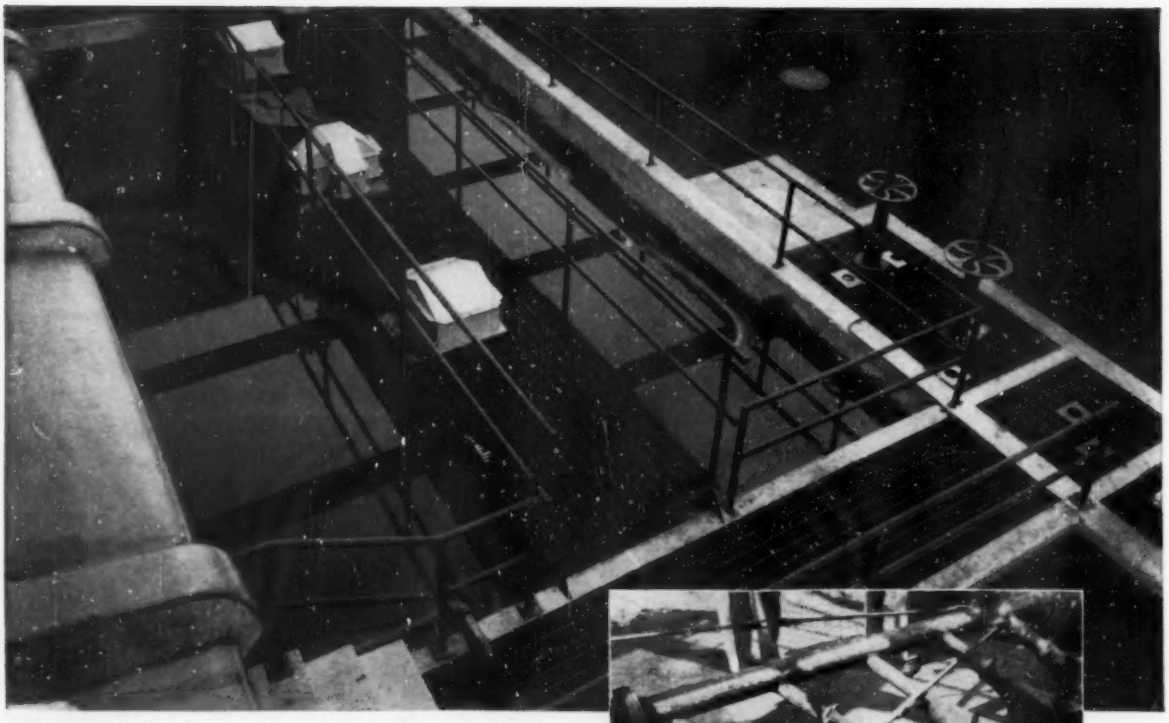
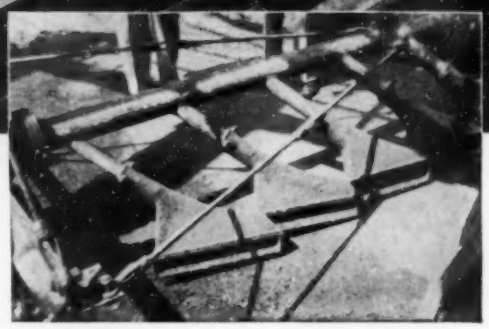
REX® TOW-BRO®



Barrington, Illinois—Sludge treatment plant. Consulting Engineers—Consoer, Townsend and Associates; John H. D. Blanke—Chairman, Sewage Commission; Fred Hager—Plant Superintendent. Mr. Hager reports, "Had 20 years' service with Rex Tow-Bro and very satisfied. Expect even better performance with new Rex Unitube Tow-Bro."



20 years' steady service ...and look at its near-perfect condition!

20 years, no trouble. That's the service record of Rex TOW-BRO at Barrington, Illinois. And a close look at this unretouched photo indicates there are 20 years' more service still there.

Long-time performance like this is essential to your plant, too. But more than this is the remarkable efficiency of the Rex TOW-BRO Sludge Remover. Now improved with new UNITUBE design, there is even more gentle suction action. Agitation is at absolute minimum. Sludge removal rate is faster, even with high solids concentration. It more effectively handles light, flocculent and "tricky" sludges.

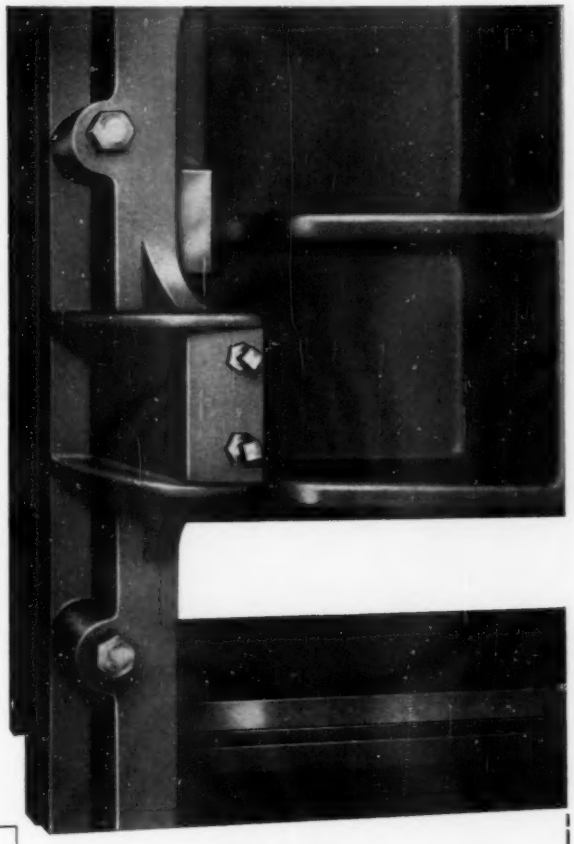
Most important to budget-conscious communities, this new simpler Rex UNITUBE TOW-BRO—while actually performing more efficiently—saves in equipment costs. Fits any tanks, new or existing. Bulletin No. 315-81 has the complete money-saving story. Write to: CHAIN Belt Co., 4722 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT COMPANY

MILWAUKEE 1, WISCONSIN

Armco Gates with flush bottom openings give you increased capacity, flushing action, uninterrupted flow

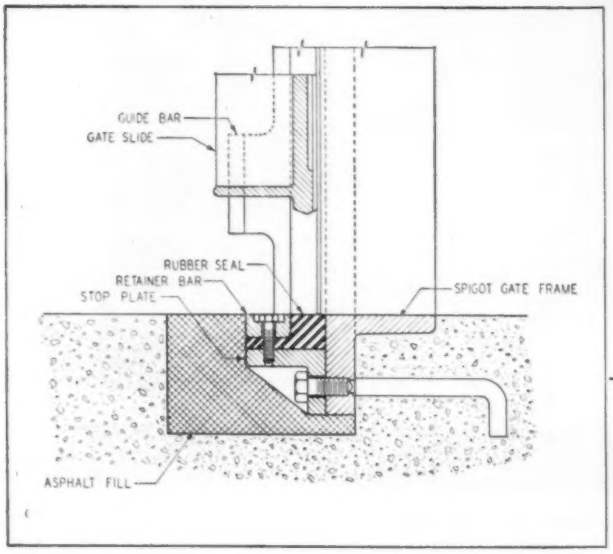
Close-up view of Armco flush bottom opening.



Flush bottom openings in various Armco Gates provide a continuous flat bottom channel across the bottom of the gate opening. There are no protrusions to interfere with flow or to catch debris and solids when the gate is open. Since only the top surface of the rubber seal is exposed, these openings are equally efficient for flow or operating heads in either direction. You can get the flush bottom opening on all sizes of Armco Series 35-05, 55-10, 55-20, and 100-30 Gates (more than 200 different gates).

Armco Gates are also available with standard perimeter seating. Sizes range from 6-inch square or circular openings to 108 inches. They are available for face heads up to 100 feet, back heads up to 30 feet.

Send coupon for folder, "Armco Gates for efficient, trouble-free water and sewage control." Armco Drainage & Metal Products, Inc., 3058 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.



Armco Drainage & Metal Products, Inc.,
3058 Curtis Street, Middletown, Ohio

Send me the folder, "Armco Gates for efficient, trouble-free water and sewage control." I am interested in Armco Gates for the following uses

_____

_____

_____

Name _____

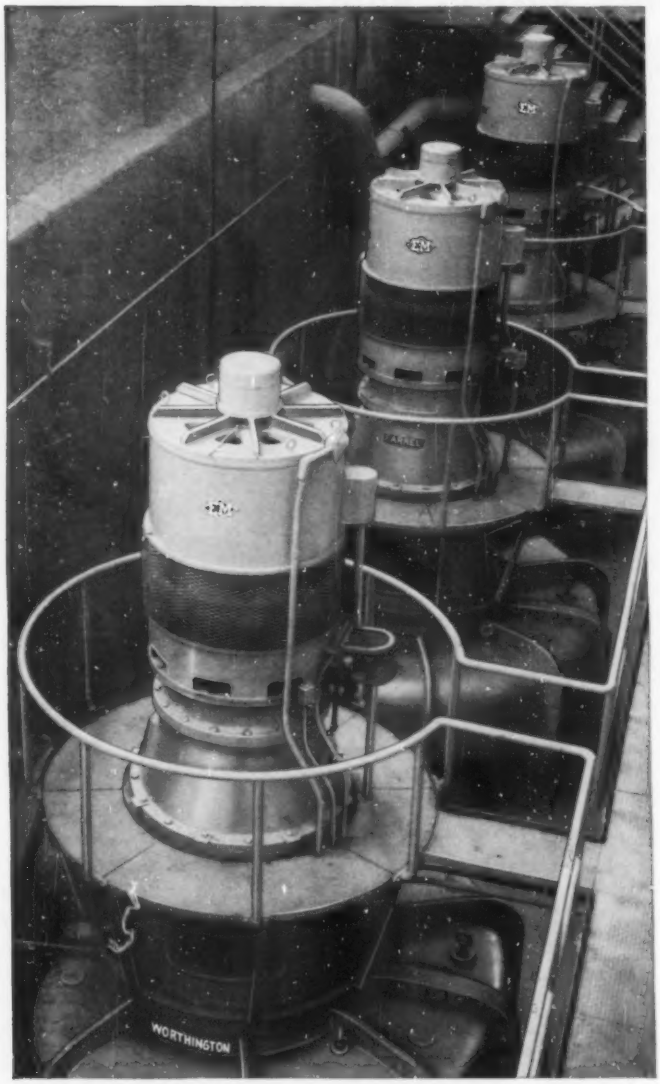
Organization _____

Street _____

City _____ Zone ___ State _____

ARMCO GATES

Sewage Pump Well Elevation Held at 114.5′±3″ Despite Big Variations in Flow



Three of four E-M 200 hp, 1200 rpm Vertical Synchronous Motors with Adjustable-Speed Magnetic Drives at Nut Island Sewage Treatment Plant of the South Metropolitan Sewage System in Quincy, Massachusetts.

E-M Vertical Synchronous Motor and Magnetic Drive Unit for adjustable-speed power transmission to vertical centrifugal pump. The ring element (1) mounted directly on the motor shaft turns at motor speed. The magnet element (2), mounted inside the ring element, has no mechanical connection to the motor . . . torque is transmitted through magnetic flux linkage between ring and magnet. By varying amount of excitation to magnet, pump speed can be precisely controlled.

AMAZINGLY PRECISE CONTROL OF SEWAGE PUMPS OBTAINED WITH E-M ADJUSTABLE-SPEED MAGNETIC DRIVES

One of the critical problems in operating Boston's new Nut Island Sewage Treatment Plant is complete control over the wide daily, weekly or seasonal flow variations. For example, flows may vary from 63 mgd to 249 mgd, with peak loads of nearly 300 mgd during stormy periods.

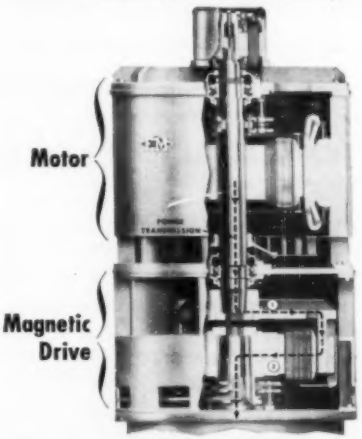
The pump well has to maintain an elevation of 114.5 feet with not more than 3 inches variation, to assure proper levels and flow velocities in the sewage processing channels. Control of the output of the low-lift sewage pumps has to be fast and remarkably accurate.

Use of E-M Adjustable-Speed Magnetic Drives for the low-lift pumps provides the sensitive speed control necessary in maintaining this close command of the pump well elevation.

Pump speed changes are dictated by a well float that actuates the Magnetic Drive through an E-M "Regutron" Control. Pump speed is automatically increased or decreased to maintain precisely the required pump well elevation. The Magnetic Drives are highly important and effective factors in most efficient operation of the Nut Island Sewage Treatment Plant for eliminating pollution in Boston Harbor.

For more information, see your nearest E-M sales engineer. And write direct for a copy of E-M Synchronizer No. 38 which tells the complete story of this outstanding installation.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA



E-M

Specialists in making motors do
EXACTLY WHAT YOU WANT THEM TO

4400-TPA-2149

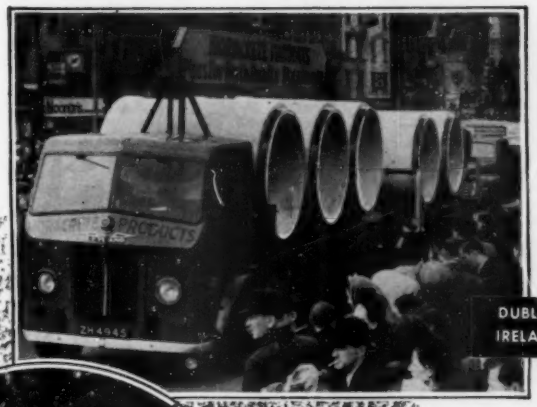
Wherever sewer and drain lines are being built for long, trouble-free service

YOU'LL FIND

TYLOX

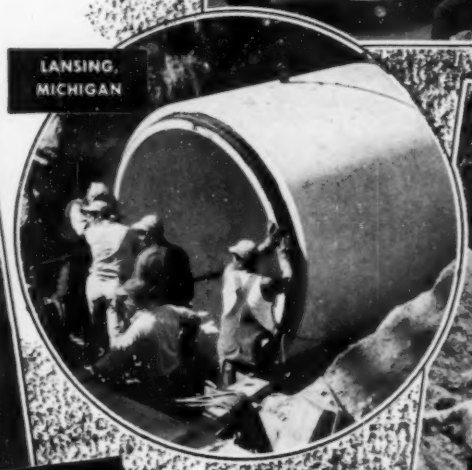
flexible RUBBER GASKETS

on the job . . .



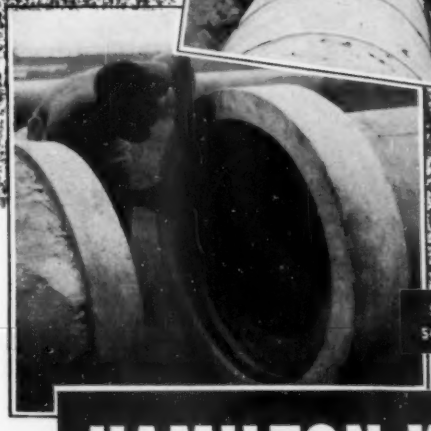
DUBLIN, IRELAND

MIAMI, FLORIDA



LANSING, MICHIGAN

BOULDER, COLORADO



SASOLBURG, SOUTH AFRICA

In America, and all over the world, engineers and contractors call on TYLOX flexible RUBBER GASKETS to prevent infiltration at pipe joints . . . to eliminate costly trench-work delays and speed pipe-laying . . . to defeat corrosion and insure water-tight, maintenance-free joints for the "life of the pipe itself". That's why TYLOX Gaskets were specified for the big pipe projects shown here . . . why they are specified for most waste disposal projects . . . everywhere!

WRITE TODAY for the facts on TYLOX, the *only* flexible pipe-joint meeting requirements of engineers, contractors and taxpayers alike. Read the facts, and take advantage of this champion of pipe joints by specifying "TYLOX RUBBER JOINTS" on your next job.

THE ONLY PERMANENTLY TIGHT LINES ARE LAID WITH RUBBER JOINTS

5018

HAMILTON KENT MANUFACTURING COMPANY

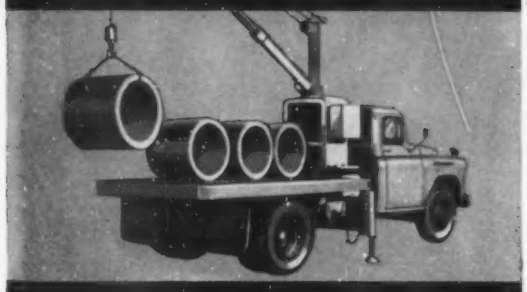
KENT, OHIO

427 West Grant St. Orchard 3-9555

first... GET THE FACTS ABOUT
MUNICIPAL TRUCK EQUIPMENT
from DAYBROOK

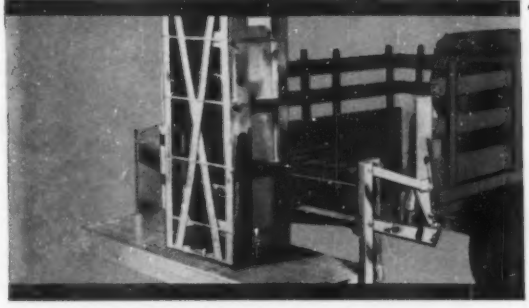
* Dump Bodies and Hoists

Daybrook dump bodies available for every municipal use. Many hoist series for proper "team-up" of hoist-body unit.



* Power Loader

. . . a crane for truck loading and unloading operations. Lifts up to 4000 lbs. within 360 degree area of truck.



* Power Gate®

the preferable method of loading—unloading trucks with ease and safety. Five series to 4000 lbs. capacity.

*

Increased Efficiency for MUNICIPAL TRUCK OPERATIONS

Daybrook has the method for modern materials handling by truck. Hundreds of cities, towns, villages, counties everywhere depend upon Daybrook equipment to make budgets go farther . . . gives them *more* than just truck transportation.

DAYBROOK POWER PACKER—*a new standard in refuse collection equipment. Exclusive Force-Crush-Pack action provides overall efficiency—speeds up the job.*

Write for Daybrook portfolio of truck equipment especially prepared for municipal management. Address Dept. PW-1.

DAYBROOK Speedlift TRUCK EQUIPMENT

DAYBROOK HYDRAULIC DIVISION
YOUNG SPRING & WIRE CORPORATION, BOWLING GREEN, OHIO

STATISTICAL ABSTRACT OF THE UNITED STATES, 1957

This book is the standard summary of statistics on the social, political and economic organization of the United States. It is designed to fulfill two functions: First, to serve as a convenient volume for statistical reference; and second, to serve as a guide to other statistical publications and sources. This edition, the 78th annual issue, presents data for the most recent year or period available during the early part of 1957. This 1045 page book is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at $3.50 per copy.

METAL GRATING HANDBOOK

A 32-page technical publication on metal gratings includes informative text, schematic drawings, tables and actual installation photographs as well as complete standards and specifications. The handbook represents a complete product standardization in the metal grating industry. Copies are available from Metal Grating Institute, Inc., One Gateway Center, Pittsburgh 22, Pa., and are $1 per copy.

BITUMINOUS PAVING MIXTURES

This bulletin contains two papers on bituminous paving mixtures. The paper "State Practices in the Use of Bituminous Concrete" was presented by W. E. Chastain, Sr. of the Illinois Division of Highways and gives information furnished by 50 highway agencies concerning standard specifications requirements. The second paper "Foamed Asphalt in Bituminous Paving Mixtures" was prepared by Ladis H. Csanyi of the Engineering Experiment Station, Iowa State College. This paper reports a study of the feasibility of producing a foam of bituminous binder in several forms. Bulletin 160 is available from the Highway Research Board, 2101 Constitution, Washington, D. C., and is $2.40 per copy.

WHATEVER YOUR SEWAGE PUMPING REQUIREMENT . . .

Smith & Loveless HAS A

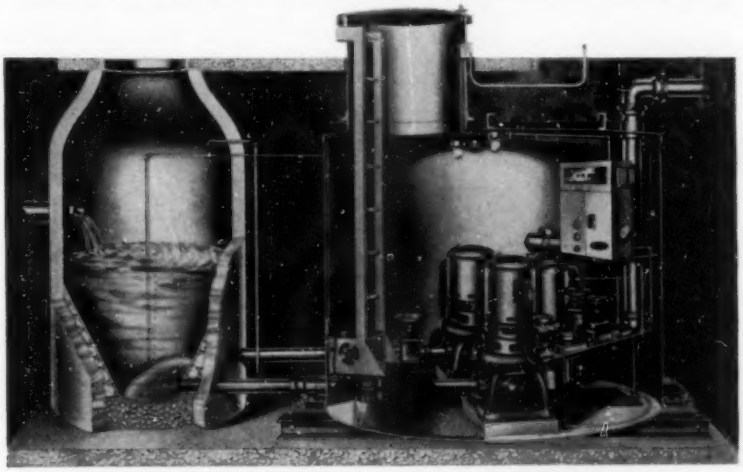
FACTORY-BUILT SEWAGE LIFT STATION

WITH CAPACITIES 20 G.P.M. TO 4500 G.P.M.

Smith & Loveless manufacture a complete line of both pump and pneumatic ejector type factory-built sewage lift stations. Built by factory experts, of the very finest quality materials, factory-tested and approved before delivery to the job site, ready to connect to power and piping.

Everything possible is built into Smith & Loveless stations to provide maximum efficiency and long life with minimum maintenance. Quality has been proven, over the years, by hundreds of installations in over 30 states. If you have a sewage pumping problem, you'll find that the easiest and least expensive solution is a Smith & Loveless factory-built sewage lift station.

Write for the Smith & Loveless 120 page Data Manual, containing engineering design notes, selection charts, dimension prints, typical installation drawings, specifications, and a representative list of installations.

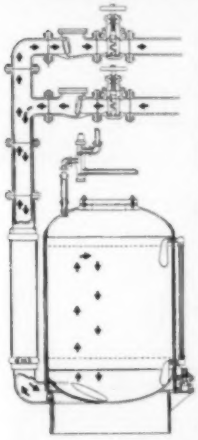


AMERICA'S FINEST FACTORY-BUILT DUPLEX SEWAGE PUMPING STATION

Here is the most advanced design in sewage pumping stations. Precision assembled, pumps with pressurized mechanical seals, dehumidified to prevent condensation, central electrical control cabinet prewired and color coded, protected with anodes and S&L "VERSAPOX" exterior coating.

Smith & Loveless offer a complete line of standard size pumping stations with capacities up to 4500 G.P.M. Larger capacities built to your order.

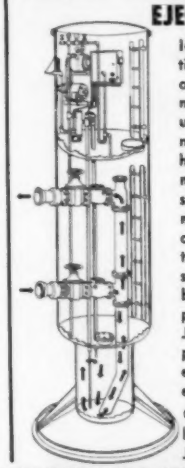
Smith & Loveless "WAY-O-MATIC" FACTORY-BUILT DUPLEX SEWAGE EJECTOR



Ideal for installations such as sub-divisions, lift stations, or sewage treatment plants requiring capacities of 200 G. P. M. or less. Since sewage does not come into contact with any part of the control system, the "WAY-O-MATIC" design practically eliminates maintenance.

The "WAY-O-MATIC" may be ordered as a separate unit or in a complete duplex lift station. Cutaway drawing shows operating cycle.

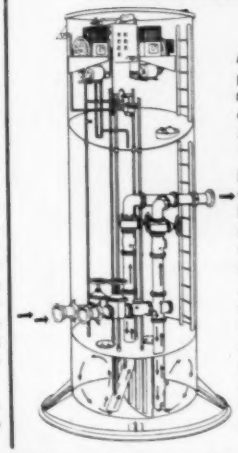
Smith & Loveless "MON-O-JECT" FACTORY-BUILT SINGLE PNEUMATIC SEWAGE EJECTOR STATION



Ideal for small installations of 200 G. P. M. or less. Requires a minimum of space. Installed underground, eliminates unsightly pumphouse. Completely automatic, extra large air storage, requires minimum maintenance. Built of the very finest materials and meeting the same high standards set by all Smith & Loveless products. The "MON-O-JECT" is designed to provide automatic equipment for the modest budget.

Cutaway drawing shows how the "MON-O-JECT" operates.

Smith & Loveless "DU-O-JECT" FACTORY-BUILT DUPLEX SEWAGE EJECTOR STATION



Most small sewage lift projects are served most economically and dependably by a Smith & Loveless "MON-O-JECT" single pneumatic sewage ejector lift station. If duplex equipment must be provided throughout, the Smith & Loveless "DU-O-JECT" duplex pneumatic sewage ejector lift station meets the requirement most economically.

Cutaway drawing shows how the "DU-O-JECT" operates.

ALL S&L PRODUCTS ARE PROTECTED WITH S&L "VERSAPOX" EPOXY COATINGS

MAKERS OF WATER AND SEWAGE TREATMENT EQUIPMENT

S&L *Smith & Loveless, Inc.*

P. O. BOX 8884 KANSAS CITY 15, MO.

PLANT: MERRIAM, KANSAS

REPRESENTATIVES IN PRINCIPAL CITIES

For job recommendations, complete specifications and drawings, all part of the latest edition of the Smith & Loveless lift station data manual.

WRITE DEPT. 40

GENERAL CONTROLS HYDRAMOTOR ®

Hydramotor H-3—This model has cast carbon steel body gate for tight shut-off of gas, oil or liquids. 1000 psi. Motor is explosion-proof, weather-proof. Typical use: high pressure shut-off on oil wells.

ADVANCED DESIGN HYDRAMOTOR

A MOTOR VALVE YOU CAN USE ANYWHERE!

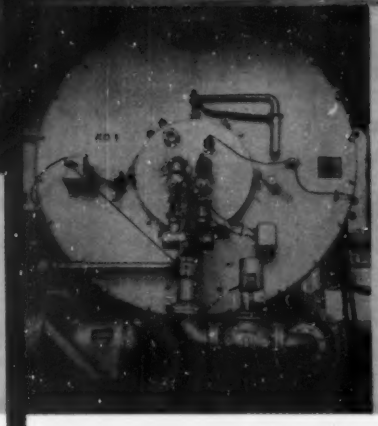
Here is a motor valve that's truly versatile... the General Controls Hydramotor! A complete line covers positive shut-off control for gases and liquids at all pressures, and they're at home anywhere, inside or out, hot or cold.

Simple, rugged electro-hydraulic operators operate on two-wire electrical circuits... they fail-safe under powerful steel spring closure in the event of power interruption. Fast and slow opening and closing speeds available.

Write today for the complete Hydramotor Catalog, or contact the nearest General Controls branch listed in the yellow pages.

NO BRAWN NEEDED

This ion exchange chamber for boiler feedwater treatment has 17 Hydramotors for flow control. The boiler room crew can busy itself on more important duties than tending valves!



RUGGED, OUTDOOR TYPE

These gathering system valves are always ready. A simple two-wire circuit is all you need to control a Hydramotor. It works easily at any temperature... arctic cold or desert heat, where personnel couldn't ordinarily reach a manual valve.

POSITIVE SHUT-OFF

sold this package boiler manufacturer on applying this Hydramotor on the fuel line to this big gas-fired boiler... he wanted positive shut-off, tight sealing, in current failure or "over temperature" situations. FM & U.L. approved.

Five Plants
Glendale, California
Burbank, California
Iron Mountain, Michigan
Skokie, Illinois
Guelph, Canada

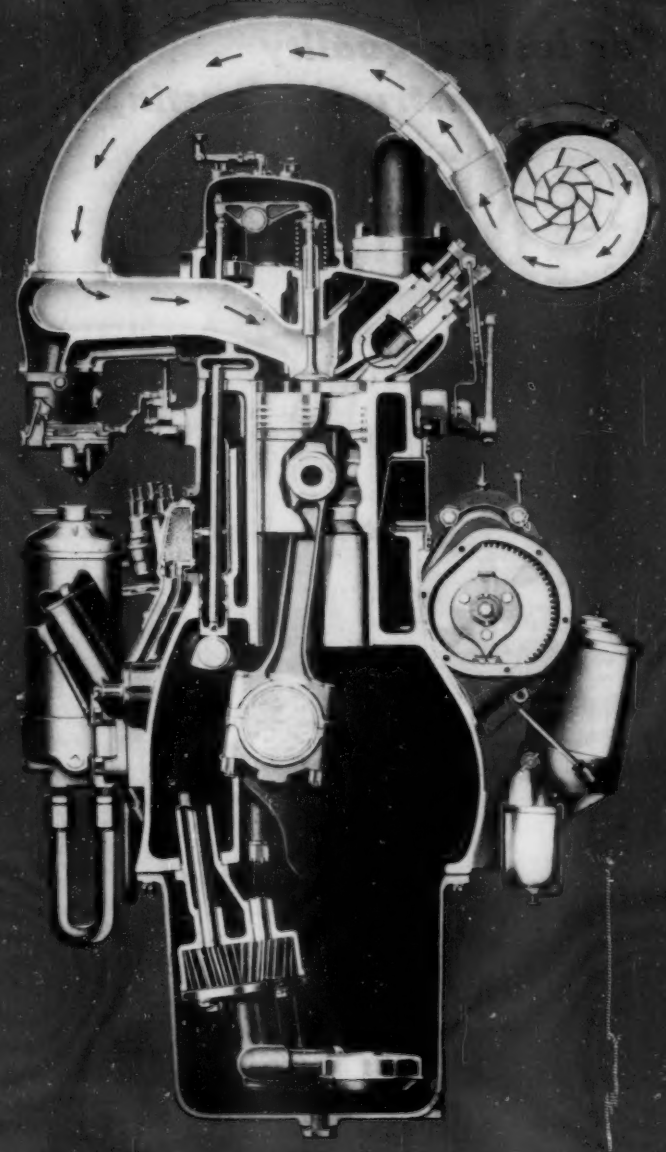
GENERAL CONTROLS

America's Finest Automatic Controls for Home, Industry, and the Military

Factory Branch Offices Serving *All* Principal Cities of the United States and Canada

Sectional view of new UDT-1091 Turbotorque diesel engine. Engine bhp (less fan): 300 max. output; 265 intermittent; 215 continuous @ 1,500 rpm.

LET'S FACE IT!



New International UDT-1091 Turbotorque® diesel costs less on any application needing dependable 265 bhp.

When you spend big money for big power, get big production returns with the dependable diesel engine that costs less to operate—the new International UDT-1091 Turbotorque.

You can depend upon the efficient UDT-1091 to cut consumption of low-cost No. 2 diesel fuel while maintaining 265 intermittent load hp at any altitude up to 10,000 feet.

As in all seven famous International diesels, you can depend also upon the UDT-1091 giving you: 1) a full measure of lower cost power; 2) super-sealing against life-robbing abrasives; 3) easier, faster starts in any weather; and 4) simple, rugged 4-cycle design.

Get the full facts and figures on why Internationals are the most economical diesels you can own. See your nearby International Power Unit Distributor or Dealer soon. He's a man you can count on for dependable power recommendations and the finest engine service in the industry.

INTERNATIONAL® **CONSTRUCTION EQUIPMENT**

International Harvester Company
180 N. Michigan Ave., Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors ... Self-Propelled Scrapers ... Crawler and Rubber-Tired Loaders ... Off-Highway Haulers ... Diesel and Carbureted Engines ... Motor Trucks ... Farm Tractors and Equipment.

for lasting quality construction castings

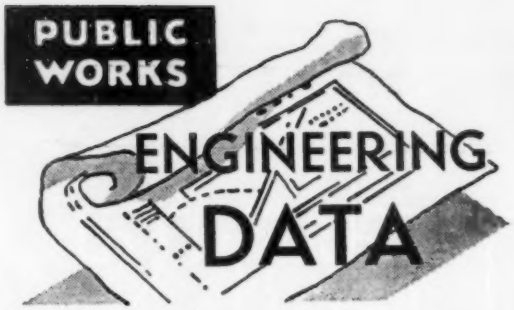
SEE NEENAH FIRST

More and more building contractors specify NEENAH fine quality construction castings FIRST. The Neenah line also includes manhole frames and covers, catch basin inlets and many other items to meet any construction requirement. Write today for your free copy of Catalog "R," second edition: 140 pages with pictures and description.

NEENAH FOUNDRY COMPANY

NEENAH, WISCONSIN

Chicago Office — 5445 N. Neva Ave., Chicago 31, Ill.



Equipment for Helicopter Insecticide Dispersal

To take advantage of the widening use of the helicopter by the Naval service, a project was established two years ago at the Medical Field Research Laboratory, Camp Lejeune, N. C., for the development of insecticide dispersal equipment suitable for use on the larger models of Navy and Marine Corps helicopters. A prototype liquid dispersal apparatus suitable for this purpose has been completed, successfully field tested, and used. This device consists essentially of a pair of spray booms extending out on both sides of the helicopter fuselage in a delta design, with the pumping assembly and reservoir mounted within the cargo compartment. The insecticide is discharged from the booms through a series of Tee-jet brand nozzles and is distributed over a wide area by the turbulence provided by the helicopter rotors.

Features of this equipment which distinguish it from all previous helicopter insecticide dispersal equipment are that it can be constructed from standard equipment and can be readily and quickly mounted and dismounted without significant alterations to the aircraft. For the first time, a Navy potential exists for the selected spot treatment with insecticides of otherwise inaccessible or difficult to treat areas. Standardization and subsequent production of this new equipment item are under consideration by the Bureau of Aeronautics.

Colorado State Highway Maintenance Program For 1956

In 1956, the Colorado State Highway System was composed of 8,140 miles of highways. Under the law the State is responsible for the maintenance of each mile of its system, regardless of whether it is located in a rural area or within the incorporated limits of a city or town. The law permits the Department to contract maintenance to the other public agencies in the State if, by such contract, the public interest is served.

During 1956, 91.05 percent of all maintenance work on State highways was performed by its own forces; 6.17 percent was contracted to counties in the form of maintenance on Federal Aid Secondary highways and State highways without Federal status; 2.52 percent was performed for the State by cities and a minor amount was performed for the State by the Bureau of Public Roads on forest highways that were situated on the State Highway System.

The total maintenance expenditure of $7,998,916 divided by the 8,140 miles of State highways indicates an annual cost of maintenance of $982.67 per mile. This figure converts to $2.69 per mile per day.

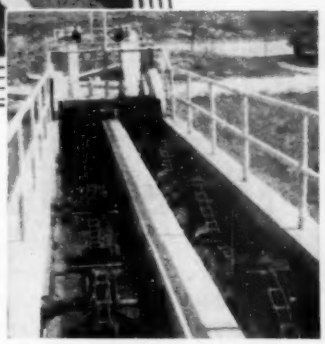
This data appeared in Colorado's Annual Highway Report for 1956. This publication is available from the Colorado Dept. of Highways, 4201 E. Arkansas Ave., Denver 22, Colo.

How to pre-determine grit collection efficiency

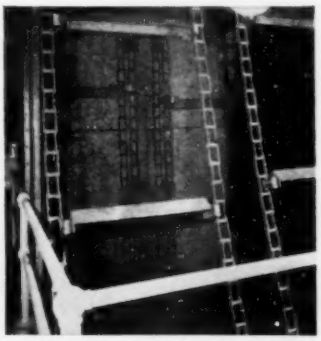
LINK-BELT'S 28-page Book 2571 is most comprehensive ever compiled on grit collectors

CONTAINS FULL DIMENSION AND SPECIFICATION DATA ON LINK-BELT'S COMPLETE LINE

HERE'S a sure guide to selecting the exact equipment necessary for effective grit collection . . . in any size sewage or industrial waste treatment plant. Charts, tables and diagrams clearly explain which combination of chamber design and equipment best suits your particular conditions and requirements . . . not only in removing grit but in minimizing its putrescible content. You can obtain a copy of this reference book by calling or writing your nearest Link-Belt office.

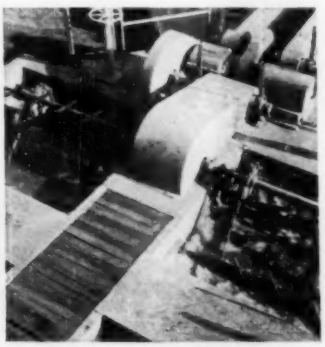


TYPE S — This chain and pitched flight Straightline grit collector is designed for shallow channels . . . discharges grit to washing and dewatering screw at influent end of chamber.



TYPE B Straightline grit collector is ideal for deep channels. It consists of either a single or double strand collector with buckets that elevate grit to washing and dewatering screw.

TYPES IH AND IM Straightline grit collectors economically remove inorganic solids or sewage grit where no washing is desired. Flights dewater material as it is elevated to discharge point.



TYPES AB, AS, AND ASB Straightline aerated grit collectors use compressed air to create and maintain velocities which produce optimum conditions for separating solids at all flows.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,758

As Simple As A Stopper In A Bottle -->

ALTITE JOINT

By APCO

Advantages Of An ALTITE JOINT!

Permanently flexible and Bottle-Tight joints reduce maintenance cost to a minimum.

Longer lengths and ease of installation yield added footage laid per hour even with unskilled labor.

Simple design—no ridges or grooves in gasket seat to collect dirt and complicate cleaning the seat in wet or dry trenches.

Gasket is **REVERSIBLE**—Cannot be installed wrong.

Four Operations As Simple As Falling Off a Log—

Insert Rubber gasket in bell end of pipe—you can't put it in wrong—A child can do it.

Wipe on a small amount of special lubricant—This reduces friction.

Insert plain beveled end of pipe—there are no grooves, ridges or tips on gasket to interfere with smooth insertion.

Small amount of pressure required to force plain end to bottom of socket—Your simple, time saving joint is completed.

For The Best Connection You'll Ever Make—Contact APCO

SALES OFFICES

122 South Michigan Ave. Chicago 3, Illinois

350 5th Avenue New York 1, New York

950 Dierks Building Kansas City, Missouri

18505 West Eight Mile Road Detroit 41, Michigan

ALABAMA PIPE COMPANY

General Offices—ANNISTON, ALABAMA

Municipal Refuse Collection in Small Communities

A study of municipal refuse collection and disposal practices in Ohio has been published by the Ohio Municipal League. Data on collection services in villages and smaller cities show that 38 such communities, varying in population from 475 to 25,000, utilize 35 packer type and 36 open body trucks; 15 of them have separate collection and 23 have combined. No charge for collection service is made by 21 of the 38; and 20 of the total require that the collection service provided by the municipality must be used. Most places provide one collection a week.

Cost of Laying Water Pipe in 1956

The Hartford County, Conn., Metropolitan Water District report for the calendar year 1956 gives the following costs for laying water pipes during that year: 4-in., 267 ft. laid at a cost of $3.52 per foot, of which $1.899 was for labor, $1.585 for material and $0.036 for miscellaneous; 6-inch, 1993 ft. laid at a cost of $4.228 per foot, of which $1.537 was for labor, $2.555 for material and $0.136 for miscellaneous; 8-inch, of which 18,381 ft. were laid at a cost of $5.625 per ft., with $1.715 for labor, $3.767 for material and $0.143 for other; 12-in. 9.931 ft. laid at $7.812, with $1.737 for labor, $5.785 for material and $0.29 for other; and 16-in., 2.032 ft. laid at a cost of $14.957 per ft., with $3.485 for labor, $11.345 for material and $0.127 for other.

Comparative costs for other years were: For 4-in., $3.988 in 1955 and $4.452 in 1951. For 6-in., $6.050 for 1955 and $4.201 for 1954. For 8-in., $5.046 in 1955 and $5.435 in 1954. For 12-inch, $6.995 in 1955 and $8.254 in 1954. For 16-in., $10.697 in 1955 and $9.616 in 1954.

Reducing the Cost of Refuse Collection

In submitting his budget for the calendar year 1958, Russell W. Rink, City Manager of Toledo, Ohio, included the following statement in regard to refuse collection:

The estimated 1957 expense for this operation is $1,197,558. The proposed Budget contemplates an expenditure of $944,846 or a reduction of $252,712. This will be achieved by a complete revision of the routes and working methods and a consequent reduction in the number of men and pieces of equipment. The number of men will be reduced from 222.25 to 162.50, and the number of trucks in daily operation will be reduced from 50 to 32. No reduction in the amount or type of service is to be made.

The refuse collection routes presently used are an outgrowth of the old garbage routes and have grown without particular attention to efficiency. Adjustments have not been made to take advantage of modern refuse collection equipment and the change in the type of refuse disposed of in an era of packaged foods and gas and oil heating.

A detailed study made by the Assistant to the City Manager of Toledo's operation compared to that of Akron, Dayton, and Cincinnati indicates that the number of collections per man in Toledo are low. In Dayton, which has an operation comparable to that of Toledo, the number of collections per man is 325 a day, whereas, in Toledo the number is only 121. A study made by the University of California of 13 cities corroborates the data developed in Toledo and also provides valuable time study information. Our refuse crews work approximately 5½ hours a

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day. Akron had a similar problem in that their crews were working an average of 3.7 hours a day and making 191 pickups per man. The University of Akron made a time study of the operation, and the present pickups per man have been increased to 250 with additional improvement recommended.

The refuse system recommended as a part of this Budget will involve the use of four collectors on 26 trucks and two collectors on six trucks. The present practice is to use three collectors on a truck. The work day will be increased to 8 hours instead of the present 5½ hours. It is recognized that any type of work involving the coverage of a route with fixed boundaries must encompass the elements of an incentive system because it is not possible to adjust the routes daily. The prime fault with the Toledo system has been that the work standards have been much too low. The system proposed allows ample time to complete a route within a normal 8-hour day when the loads are heavy and during inclement weather. The balance of the time the crews can complete their work in less than eight hours, a privilege that the majority of City employees do not enjoy.

Rubbish and Garbage Collection and Disposal

It cost an average of $7.79 per ton for collection of rubbish in Newton, Mass., during the fiscal year 1956, based on collections of 29,067 tons. It cost $2.35 per ton for incineration, based on disposal of 29,441 tons. Also, 7,622 tons of garbage were collected at a cost of $13.19 per ton. Street cleaning, covering 3,285 miles of streets, produced 14,081 cu. yds. of sweepings. The cost was $7.63 per cubic yard or $32.72 per mile.

Cost of Repairing and Renovating Meters

For the fiscal year 1956-57, the average cost of labor and parts for repairing and renovating 28,682 water meters is reported by Henry J. Graeser, Superintendent, Water Department, Dallas, Tex., as follows:

Size	*No. Worked*	*Labor*	*Parts*	*Total*
	27,304	.80	.46	1.26
¾″	112	1.31	.48	1.79
1″	635	1.36	.85	2.21
1½″	201	1.70	2.32	4.02
2″	349	2.50	4.23	6.73
3″	32	13.90	2.95	16.85
4″	30	19.11	5.57	24.68
6″	19	26.87	5.54	32.41

During the fiscal year, 25,405 meters were exchanged at an average cost of $1.12 each and 1,481 meters were removed at an average cost of $1.13 each.

Refuse and Street Cleaning Costs

The Arlington County, Va., Department of Public Service collects refuse and cleans streets throughout the County. In 1957, refuse collection and disposal costs aggregated $568,492, which included a pro rata share of administrative costs. This amounted to $3.42 per capita, compared to $3.25 in 1956. The cost of street cleaning was $69,141 or 42 cents per capita.

An addition to the refuse incinerator was completed. Facilities now consist of two 150-ton furnaces in the original incinerator building plus two 150-ton furnaces with space for a third unit in the addition. Refuse burned during the fiscal year amounted to 73,515 tons, an increase of 12½ percent over the previous year. Incinerator operation cost $114,531. Refuse incinerator fees brought in $11,560. Equipment in use includes 22 refuse trucks, two leaf collectors and a sweeper.

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Catalog on Dewatering Pumps

226. Centrifugal and diaphragm pumps for dewatering jobs are described in Catalog DP7 from The Jaeger Machine Co., 550 West Spring St., Columbus 16, O. Models, specifications and performance tables are included. Check the reply card.

Manual on Coatings to Stop Rust

235. Primer type, short oil type, heat resistant, chemical resistant and floor coatings are a few of the items covered. Also complete data on Rust-Oleum products are included. Check the reply card or write Rust-Oleum Corp., Evanston, Ill., for this valuable manual.

Refuse and Garbage Packer Bodies

241. Ranging in capacity from 12 to 24 cu. yds., the M-B packers have a 30 second compaction cycle and have large side loading doors. Write M-B Corp., New Holstein, Wisc., or check the reply card for bulletin on specifications.

Zeolite Water Softeners

486. Features of Allis-Chalmers zeolite water softeners are described, and an explanation of how the company's standard units can be easily adapted to meet individual plant requirements where the applications involve elimination of costly maintenance due to the treatment of municipal water supplies are included. The flexibility of standard designs permits selection of a variety of sizes to meet individual installation requirements. Check the reply card or write Allis-Chalmers, Milwaukee 1, Wis., for Bulletin 28B7107A.

Mueller Copper Water Meter Yokes

242. Copper meter yoke provides a tailor-made setting with fewer joints and fittings and it permits the installation of service lines without placing the meter. Check the reply card or write Mueller Co., Decatur, Ill., for complete information.

Waste Receptacles For Municipalities

253. Bennett self-closing and drop-in waste receptacles, garbage can enclosures and drum tops that convert any 50 gallon drum into self-closing receptacles are described in Catalog No. 1157 from Bennett Mfg Co., Alden, N. Y. Check the reply card.

Handbook on Silent Drive Chains

267. Handbook contains detailed engineering data and illustrations of silent chain drives. Check the reply card or write to Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill., for Book 2425.

Water Purification Equipment

283. Water softeners, deionization equipment and ion exchange water treatment equipment are covered in literature from H. M. Mueller Corp., 3340 Gorham Ave., Minneapolis 26, Minn. Types of equipment, water treatment terminology and application features are covered. Check the reply card.

Data on Air Placing Concrete Machines

291. A wet mix, all purpose pneumatic concrete gun is described in Bulletin GA857 from True Gun-All, P. O. Box 2526, Tulsa, Okla. Features, applications and specifications are included. Check the reply card.

Planning a Steel Tank

333. Shells, bottom and roof design and foundation preparation procedures for steel tanks for all purposes are presented in 26-page Catalog 54B issued by Hammond Iron Works, 630 Fifth Ave., New York 20, N. Y. Check the reply card.

Technical Bulletin on Swimming Pool Filtration Equipment

335. A 24-page technical Bulletin 626, designed to help persons planning pools which must comply with local and state health regulations, is now available from the R. P. Adams Co., Inc., 328 East Park Drive, Buffalo 17, N. Y. Check the reply card for data on size selection charts, typical installations and drawings.

Device Used to Regulate Flows of Liquids

396. Valuable data on details of design, capacities, dimensions and typical installations of the Simplex Type 5 Controller are covered in literature from Simplex Valve & Meter Co., 7 East Orange St., Lancaster, Pa. The unit regulates flow of liquids in filter plants and is used to maintain a uniform rate of filtration through each filter unit. Check the reply card.

Diaphragm & Plunger Type Dual Valve Sludge Pumps

411. A 4-page bulletin on diaphragm and plunger type dual valve sludge pumps is available from Komline-Sanderson Engineering Corp., Peapack, N. J. Sludge pump is designed for feeding sewage to vacuum filter and the diaphragm pump is intended for pumping heavy slurries. Check the reply card for complete descriptions and selection charts.

Strapping Tools and Equipment For Traffic and Street Name Signs

289. Stretchers, strap cutters, wrenches, brackets and sign supports are described in literature from A. J. Gerrard & Co., 1950 Hawthorne Ave., Melrose Park, Ill. Check the reply card for full details.

Manual on Steel and Wire for Road Building

337. Design data on wire fabric for concrete pavements, joint data, guardrail design standards, steel and wire for concrete pipe and reinforced bituminous concrete design are some of the sections covered. Check the reply card or write American Steel & Wire Div. of United States Steel Corp., Cleveland 13, Ohio, for this valuable manual.

Tractor-Shovels With Drott "Four-In-One" Attachment

352. Hough rubber-tired front-end loaders come equipped with the Drott "4-in-1" bucket. Check the reply card or write The Frank G. Hough Co., Libertyville, Ill., for literature on how to use this unit as a shovel, clamshell, scraper and bulldozer.

Solenoid Valves and Electromagnetic Controls

384. Categories covered in literature available are 2, 3 and 4-way solenoid valves and transfer switches, remote control switches, contactors and electric plant controls. Check the reply card or write Automatic Switch Co., Florham Park, N. J.

Complete Catalog on Steel Frame Buildings

421. A complete line of steel structures that provide permanent construction, flexibility and fast erection is described in 28-page catalog available from Luria Engineering Co., 1745 Eaton Ave., Bethlehem, Pa. Flat roof buildings and clear span structures up to 100 ft. and over are included. Check the reply card.

Ditcher for Water Pipe Laying

426. A vertical boom, crawler ditcher is described in literature available from Barber-Greene, 400 No. Highland Ave., Aurora, Ill. Specifications and models are fully covered. Check the reply card.

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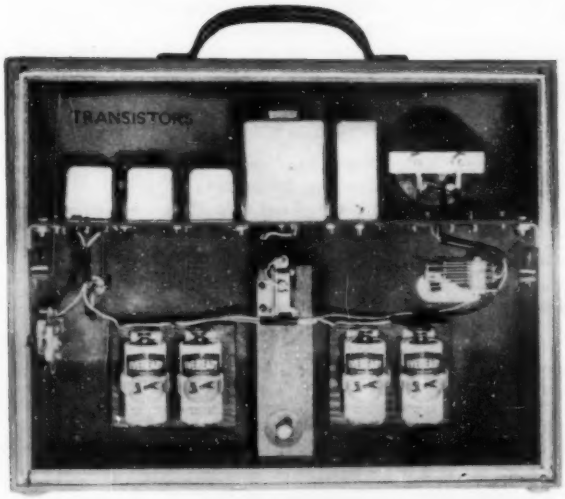

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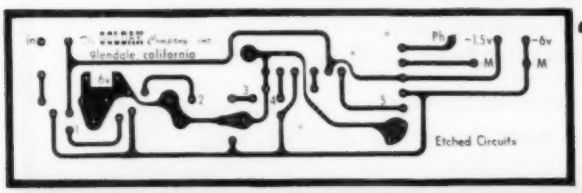

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436. Literature is available from Rynal Corp., 114 St. Joseph St., Arcadia, Calif., on plastic filaments for street sweeper pick-up brooms. They are easy to replace, storage space is eliminated and moisture will not attack them. Check the reply card.

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460. Crane valves have all-bronze internal parts and are available in hub, flanged and mechanical joint ends. Also available with ends for "Ring-tite" and "Fluid-tite" asbestos-cement pipe and in sizes from 2" to 12". For Catalog AD-2108 on these valves check the reply card or write Crane Co., Chicago 5, Ill.

Catalog on Chain Link Fence Gates, Posts and Rails

476. Standard specifications, construction and erection details and styles are covered in Catalog DH-265. Check the reply card or write Page Steel and Wire Div., American Chain & Cable Co., Inc., 230 Park Ave., New York 17, N. Y., for your copy.

Manual on Solving Drainage Problems

479. A 74-page Manual on the problems of drainage and drainage materials is available. Design section includes determining culvert lengths and sizes, run-off calculations, excavation of base and backfilling data. Check the reply card or write Bethlehem Steel Co., Bethlehem, Pa., for this valuable book.

Single-Pass Soil Stabilizer

483. The P & H Single-Pass soil stabilizer cuts and pulverizes the soil, proportions soil, asphalt, etc. and water, mixes the materials and spreads them in an uniform layer. Full details in literature from Harnischfeger Corp., 440 W. National Ave., Milwaukee 14, Wisc., or check the reply card.

Motor Valves Have Versatile Application

485. The General Controls Hydramotor is a simple, rugged electro-hydraulic valve operator powered from two-wire electrical circuits for positive shut-off at all pressures, for indoor or outdoor applications, unaffected by hot or cold temperatures. Motor-equipped valves are available or motor operators for any type of valve may be furnished. Write to General Controls Corp., 801 Allen Ave., Glendale, Calif. for complete Hydramotor Catalog or check the reply card.

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WATER WORKS

Ball and Socket River Crossing Cast Iron Pipe

33. Literature is available describing Clow ball and socket cast iron pipe for river crossing, or any installation where full 15 degree free turning deflection is desirable. For full description and specifications, address James B. Clow & Sons, Inc., P. O. Box 6600-A, Chicago 80, Ill., or check the reply card.

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27. An independent source of electricity which will supply power for vital services when regular sources fail can be invaluable during emergencies. Check Kohler Bulletin KEP 56-1 which furnishes data that will help you select the plant best suited for your needs. Many models, 500 watt to 50 Kw, portable and stationary are described. Write the Kohler Co., Kohler, Wis., or use the reply card.

Meter Features That Help Make Water Works Profitable

59. Simple design, accuracy and long life, moderate first cost and inexpensive maintenance are features of American Water meters described in Bulletin No. 56 of the Buffalo Meter Co., 2917 Main St., Buffalo 14, N. Y. Be sure you have this informative booklet which gives the details of American meter design and construction plus full data on sizes, capacities and dimensions. Check the reply card.

For Fast, Smooth Pipe Cuts

68. Descriptive literature on the Reed 4-wheel hinged pipe cutter which operates in close quarters, gives quick, easy right-angle cuts, and is available from Reed Mfg. Co., Erie, Pa. Check the reply card.

100 Page Book Helps Solve Water Problems

71. pH and Chlorine Control. A discussion of pH, Chlorine and Phosphate Control and descriptions of comparators for making colorimetric analyses. A 100 page booklet is available by checking reply card. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

Rapid Sand and Pressure Filter Data

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Designed and manufactured by a century-old concern with 40 years' experience in designing, engineering and completely manufacturing hydraulically-powered stokers.

"F&E" Hydraulically-Powered Stokers are the most talked-of incinerator advancement in the field today.

Should you wish to see an "F&E" Incinerator Stoker in operation and get firsthand information on their revolutionary performance, we will be pleased to advise where the installation nearest you is located.

F&E

FLYNN & EMRICH CO.

2301 NORTH HOLLIDAY STREET • BALTIMORE 2, MARYLAND

ROCKWELL SEALED REGISTER WATER METERS

Less to wear—Less to repair!

only two moving parts in water

The Rockwell Sealed Register Meter has only two moving parts in the flowing stream—the piston and the piston roller. All other moving parts operate—clean, dry and lubricated for life—within a hermetically sealed register casing protected against corrosion and erosion.

This sealed register forever ends condensation troubles. There can be no fogging or clouding to obscure readings. A powerful magnetic drive eliminates the need for a stuffing box, an exposed intermediate gear train and driving dog.

Simple isn't it? . . . and more accurate, too, for fewer parts mean less friction and wear, a smoother running meter and one more sensitive to low flows. Get full facts now—write for bulletin to Rockwell Manufacturing Company, Pittsburgh 8, Pa.

SEALED REGISTER WATER METER

another fine product by

ROCKWELL

Top View

Side View

End View

To order these helpful booklets check the reply card opposite page 50.

Information on Service, Valve, Roadway and Meter Boxes

122. Literature on specifications covering "Buffalo" service, valve, roadway and meter boxes, and adjustable valve boxes for water and gas has just been released from Buffalo Pipe & Foundry Corp, Box 55-Station B, Buffalo 7, N. Y. Check the reply card for your information on these valve boxes.

Engineering Data on Diatomite Filters

139. Get complete data on the Sparkler model SC-J diatomite slurry feed filter for swimming pools from the Sparkler Mfg. Co., Mundelein, Ill. Check the reply card for full information including table of filter sizes and capacities, space required and filter operation.

Valve and Hydrant Construction Details

161. A 72-page catalog-type bulletin, just completed, gives detailed data on construction and application of gate valves, check valves and hydrants for water works service. Write for Bulletin 5710 from Darling Valve and Mfg. Co., Williamsport, Pa., or check the reply card.

What You Should Know About Steel Reservoirs and Standpipes

163. In a handsome 24-page booklet "Horton Steel Reservoirs and Standpipes," the Chicago Bridge & Iron Co., Chicago 4, Ill., shows installation from 50,000-gal. to 10,000,000-gal. capacity with several types of roof and special architectural features. Engineering data includes information on capacities, foundations and improved surface protection. Check the reply card to get your copy.

All-Electric Floatless Liquid Level Control

174. Description of operating principles and application of B/W controls show the simplicity and many uses of these all-electric, floatless devices. Get latest bulletins for engineering data, diagrams of typical installations and details of component parts. Check the reply card or write B/W Controller Corp., Dept. PW, Birmingham, Mich.

Engineering Data On Mechanical Joint C.I. Pipe

183. General specification, weights and dimensions of mechanical joint cast iron pipe and fittings are furnished in a 32-page booklet issued by Alabama Pipe Co., Anniston, Ala. Get this helpful data by checking reply card.

Lay Water Mains Faster With 'Fluid-Tite" Couplings

184. Get permanent water-tight joints automatically with Century "Fluid-Tite" couplings for Century asbestos-cement pressure pipe. Full details on this faster installation and self-energizing couplings are available from Keasbey & Mattison Co., Ambler, Penna. or by checking the reply card.

Design of Prestressed Concrete Tanks

194. An 8-page technical Bulletin, T-19, on the Design of Prestressed Concrete Tanks, gives engineering data and formulas of general interest to anyone considering prestressed concrete for storage tanks. Check the reply card or write The Preload Co., Inc., 21 East 37th St., New York 16, N. Y.

Complete Catalog and Reference Data on Valves and Fittings

211. The entire M & H line of valves, fittings and accessories for water works, filtration, sewage disposal and fire protection are illustrated and fully detailed in Catalog 52 issued by M & H Valve & Fittings Co., Anniston, Ala. In addition to complete data on these products, there are many pages devoted to helpful engineering data. Every designer should have a copy.

Water Lines Under Pavements Easily Installed

247. With a Trojan pipe pusher and puller no resetting of grip is required, so the work goes twice as fast. Two models, for pipe up to 2" dia. The larger model is available with air power unit to eliminate manual pushing. Get full details by checking the reply card. Trojan Mfg. Co., 1114 Race Dr., Troy, Ohio.

Heavy Duty Air Cooled Engines For Many Uses

223. Power and weight specifications, dimensions and uses are fully covered in literature issued by Wisconsin Motors Corp., Milwaukee 46, Wis., on their air-cooled engines. Also available is a service map and a list of their distributors and approved service stations.

Auxiliary Electric Power For Public Utilities

249. Full descriptive information on Onan electric plants for every public utility need will be found in bulletin A-292 issued by D. W. Onan & Sons, Inc., Minneapolis 14, Minn. Be sure you have latest data on standby plants and controls for emergency electric power

For Prompt Service Use The Reply Card

Review of Diatomite Filtration of Water

285. A detailed review of the application of diatomite in the general field of water filtration, including uses in municipal supply and swimming pools is contained in a well-prepared 16-page bulletin. Specific applications to certain water treatment problems are also discussed. Write to the Dicalite Division, 612 So. Flower St., Los Angeles 17, Calif. for Bulletin F-552 entitled, "Diatomite Filtration of Potable Water," or check the reply card.

Factors to Consider in Elevated Tank Selection

299. Details on the several different types of elevated steel tanks, including capacity ranges, tank dimensions and other factors to be considered in the selection of elevated tanks for modern water storage, plus discussions of new tanks for old towers and foundations are included in Bulletin 101 of the Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh, Pa. Check reply card for your copy.

SAVES $ LOTS OF $

$ . . . on pipe runs under streets, highways, pavement, gardens, etc.

REG. U. S. PAT. OFF.

HYDRAUGER*

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OPEN HOLE

AVOID TIME WASTE

Hydrauger is a modern, time-saving way to install underground pipe . . . avoids trenching, backfilling, pavement cutting, etc.

2" to 24" BITS and REAMERS

HYDRAUGER CORP. Ltd.
681 Market Street
San Francisco, California

*Earth Boring Tool

ASK FOR BOOKLET . . . NO OBLIGATION

FOUR BIG REASONS for Specifying

IMCO

Floor System for All Types of Trickling Filters:

1—**It simplifies construction**—The units are self-spacing; they are easily set; they have high strength, thus permitting mechanical placing of filter stone . . .

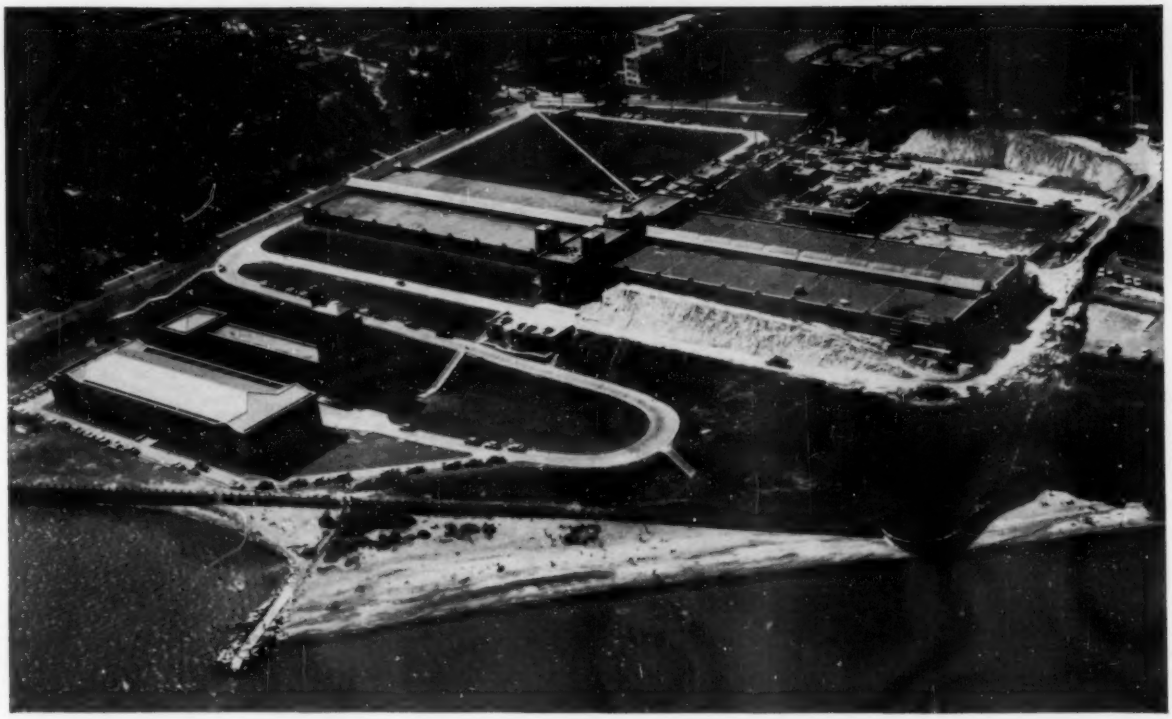
2—**It assures effective aeration**—The grill blocks afford maximum apertures, with 40% of the filter area open to ventilation . . .

3—**It provides excellent drainage**—The channel blocks are smooth and unobstructed and flush jointed . . .

4—**It gives flexibility of design**—Filter blocks are supplied in shapes and fractional sizes to fit all forms of filters without the necessity of cutting blocks . . .

Our Engineering Department will gladly cooperate with Engineers in solving the design problems of all standard and high-rate trickling filters.

INDUSTRIAL MATERIALS CO.
Somerset St. and Trenton Ave.
Philadelphia 34, Pennsylvania



Aerial view of the R. C. Harris Plant of The Municipality of Metropolitan Toronto; R. L. Clark—Commissioner of Works. Photograph was taken during construction of plant's additional facilities.

New plant extension for Toronto, Canada used Leopold Butterfly Valves

When the R. C. Harris Plant of The Municipality of Metropolitan Toronto, Canada, was constructed in 1939 with an initial capacity of 100 million Imperial gallons per day, provision was made for future extension to twice that capacity.

With the recent completion of this extension, which has been under construction since 1955, 200 million gallons per day are now available to meet the expanding needs of the fast-growing Metropolitan Toronto area. For this modern plant addition, Leopold class 50-16 rubber seat, tight shut-off 30" hydraulically operated butterfly valves were selected for use on the twenty filter wash water lines.

More and more water treatment plants are specifying Leopold equipment for dependable performance, long life, and economy. If you're planning on new plant construction or modernization of your present facilities, it will pay you to consider the advantages of Leopold products. Write for complete information, without obligation.

Workmen shown installing one of the Leopold 30" Butterfly Valves at the R. C. Harris Plant.

Leopold

F. B. LEOPOLD CO., INC.

ZELIENOPLE, PA.

COMPLETE WATER PURIFICATION AND FILTER PLANT EQUIPMENT • BUTTERFLY VALVES
FILTER OPERATING TABLES • MIXING EQUIPMENT • DRY CHEMICAL FEEDERS
GLAZED TILE FILTER BOTTOMS • FIBERGLAS-REINFORCED PLASTIC WASH TROUGHS

To order these helpful booklets check the reply card opposite page 50.

At last report there were 24 diatomite filtration plants serving municipalities in the United States—20 of them filtering the communities' drinking water. Let's summarize the reports of these 20.

SIZE OF COMMUNITY Population range from 450 to 10,000.

LENGTH OF SERVICE Plant installations date from 1949 (2) to 1956 (2). The greatest number went into service in 1952, 1954 and 1955—long enough to allow the accumulation of reliable service data.

HEALTH DEPT. APPROVAL Yes, in all cases except for one community in Oregon where the installation is classed as experimental.

WATER SOURCES Small streams, wells, rivers (including some regarded as 'flashy'), lakes, an aqueduct and a pipeline.

RAW WATER IMPURITIES Turbidity, principally, although plankton, algae, iron and color are also mentioned.

RESULTS Good to very good—6. Satisfactory—11. Fairly good—1. Problems—1 (due to seasonal concentrations of organisms).

NOTE: The fact that 12 of these 20 communities number less than 1,000 population is convincing evidence that highly-skilled personnel are *not* required for the satisfactory operation of a diatomite filtration plant, since communities of this size can seldom afford a high-salaried operator on a single-purpose job which can be handled in an hour or so a day.

Dicalite Bulletin BW-13, newly revised, contains interesting new information on diatomite filtration of municipal water supply. Write for your copy.

Dependable GLC GREAT LAKES Dicalite® DIATOMACEOUS MATERIALS

DICALITE DEPT. Great Lakes Carbon Corp., 612 S. Flower St., Los Angeles 17, Calif.

Quick Review of Water Meters

316. A helpful condensed catalog which covers sizes and types of water meters for every kind of service is available from Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa. Each type is illustrated and fully described; specifications and prices are included. Get Bulletin W-800 by checking the reply card.

Points to Consider in Filter Sand Selection

332. Best operation of rapid sand filters requires filter media which is hard, properly shaped, carefully graded and perfectly clean. Filter sand and gravel which meets these exacting requirements is available on short notice from Northern Gravel Company, Box 307, Muscatine, Iowa.

Engineering Data on Equipment for Municipal Water Conditioning

347. For information on the design and operation of many types of water treatment plant equipment, including the Graver Reactivator, pressure filters, iron removal installations, zeolite softening and water conditioning for swimming pools get Bulletin WC-113 from Graver Water Conditioning Co., 216 West 14th St., New York 11, N. Y. Check the reply card.

Testing Water Meters

353. This 40-page catalog is a discussion of fundamentals and a guide to sound practice in meter maintenance. It covers standard specifications of meter accuracy, descriptions of the latest developments in meter testing equipment and many drawings and diagrams. For your copy write The Ford Meter Box Co., Inc., Wabash, Indiana, or check the reply card.

Welded Steel Pipe from 6 to 10 3/4" Diameter

382. High grade butt welded light-weight steel pipe from 8 to 16-gauge in 20, 30 and 40-foot lengths, plain or asphalt coated, with choice of joints. Also available up to 0.188 wall. Check uses for municipal water lines, irrigation, well casings and many other applications. Self explanatory literature from Valley Mfg. Co., Valley, Nebraska.

What You Should Know About Hypochlorination

395. "Hypochlorination of Water" is the name of an informative publication issued by Olin Mathieson Chemical Corp., Industrial Chemicals Div., Baltimore 3, Md. In it there is a discussion of chlorination theory, practice and equipment; control of algae, tastes and odors; and laboratory testing.

Cleaning and Relining Water Pipe the Easy Way

397. Complete facilities for relining cast iron or steel water pipelines in place from 4" to 144" in diameter, with the Spunline (TM), Tate and Centriline Processes offered by Pipe Linings, 2414 E. 223rd St., Wilmington, Calif. For full information on cleaning and relining pipe with only momentary interruption of service, check the reply card.

International 6-Cylinder Carbureted Power Units

398. A graphically-illustrated 12-page catalog CR-511-G, on IHC 6 new 6-cylinder power units is available. Power and fuel consumption curves and cutaway views of component parts of the units are covered. Check the reply card or write Construction Equipment Div., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., for specifications.

Helpful Engineering Data on Cast Iron Pipe

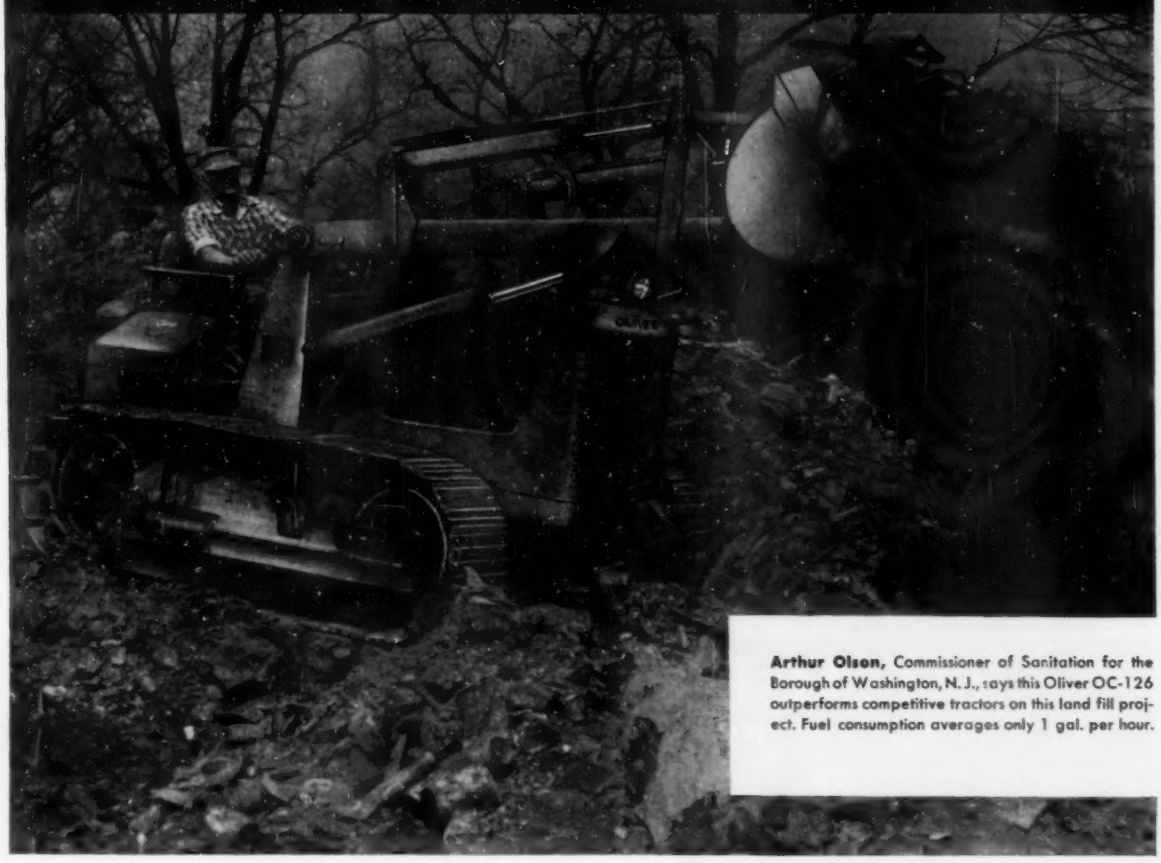
422. Complete data on McWane Super-DeLavaud centrifugally cast pipe with bell and spigot or mechanical joints is contained in Bulletin WP-54, issued by McWane Cast Iron Pipe Co., Birmingham 2, Ala. Size range includes 2" through 12" diameters, 18 feet long.

Pumps For Municipal Primary Water Supply

599. Verti-Line turbine pumps with open or enclosed line shafts are described in Bulletin 100 available from Layne & Bowler Pump Co., 2943 Vail Ave., Los Angeles 22, Calif. Table of head-capacity range is included.

OLIVER OC-126 LOADER

with new POWER-TURN steering



Arthur Olsen, Commissioner of Sanitation for the Borough of Washington, N. J., says this Oliver OC-126 outperforms competitive tractors on this land fill project. Fuel consumption averages only 1 gal. per hour.

Now **– you can cut your sanitary land fill costs**

HERE'S WHY: Oliver's exclusive POWER-TURN gives you a more maneuverable, faster working tractor. In this kind of spongy, rubbish-strewn footing POWER-TURN means perfect traction. You have full power on *both* tracks at all times for those frequent turns and tight maneuvers. You have extra digging-in power with instant planetary speed reduction —to break through banks or work grades and slopes. All around, here's the easiest handling crawler in the business.

The OC-126 is designed especially for loader work, with extra heavy frame and crawler frames rigidly mounted to main frame to take the most severe stresses. The big 1½-yd. bucket is hydraulically controlled with fast roll-back and full rotation for easy filling and dumping. Oliver's famous high-torque diesel delivers 53 drawbar h.p. to keep production moving at top speed.

On many land fill projects this *one* machine can handle the entire job—trenching, filling, compacting and covering—and at a small investment. Ask your Oliver distributor to demonstrate. Or write for literature.

OLIVER **THE OLIVER CORPORATION**

Industrial Division, 19300 Euclid Ave., Cleveland 17, Ohio

a complete line of industrial wheel and crawler tractors and matched allied equipment.

To order these helpful booklets check the reply card opposite page 50.

Important Factors in Water Meter Selection

463. Interchangeability of parts is an important advantage that is yours when you use Trident meters. The newest parts fit your oldest Tridents so you modernize when you repair. Get full data on the entire Trident water meter line by checking the reply card or write to Neptune Meter Co., 19 West 50th St., New York 20, N. Y.

3-Way Instrument Locates Underground Pipes and Leaks

540. A single instrument, the Goldak Model LC-15, provides all-around help in water system maintenance by locating pipes and valves and detecting leaks. One-man operated, accurate and dependable, this instrument is fully described in the booklet entitled "Locating Underground Pipes" and related literature. Get your copy from the Goldak Company, Inc., 1544 W. Glenoaks Blvd., Glendale 1, Calif.

Residual Chlorine Recorders For Water Plants and Swimming Pools

508. An instrument for measuring residual chlorine amperometrically in a continuous sample and recording the reading in parts per million on a 24 hour circular chart is described fully in literature available from Wallace & Tiernan Inc., Box 178, Newark, N. J.

Manhole, Water or Gas Valve Box Locator

603. A valve box locator or manhole finder is available from Aqua Survey & Instrument Co., 2012 Leslie Ave., Cincinnati 12, Ohio. Rugged and compact with no wires, batteries or switches, the Aqua box locator should be in every service car. For more information and price, check the reply card.

Flexible Plastic Pipe For Water Distribution

708. A new-type polyethylene resin flexible pipe is described in Catalog No. 401 available from Orangebrug Mfg. Co., Inc., Orangeburg, N. Y. Fittings, installation, size and weight tables and physical properties are several of the sections covered.

Palatable Water Achieved By Proper Aqua Nuchar Dosage

714. Aqua Nuchar activated carbon will render water palatable only if proper dosages are used. For complete information and technical help write Industrial Chemical Sales, Division West Virginia Pulp and Paper Co., New York Central Bldg., 230 Park Ave., New York 17, N. Y., or check the reply card.

Ball Joint Pipe For River Crossings

746. A well illustrated 32-page catalog containing instructions for assembly, weights and dimensions, and different methods of installing Molox ball joint pipe for river crossings and submarine service is available from American Cast Iron Pipe Co., P. O. Box 2603, Birmingham 2, Alabama. Check the reply card.

SEWERAGE AND WASTE TREATMENT

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay under drain blocks conforming to ASTM standards, suggestions for layouts and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute c/o Editor, Public Works, 200 So. Broad St., Ridgewood, N. J. Check the reply card and we will forward your request.

How to Make Better Sewer Pipe Joints

37. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston Co., Dept. P.W., Adams, Mass. Check the reply card.

A Handbook of Sewer Cleaning Methods and Materials

44. Complete easy-to-follow directions for every type of sewer cleaning operations and the equipment needed for effective cleaning work is covered in a 48-page booklet issued by Flexible Inc., 3786 Durango, Los Angeles 34, Calif. Full details are provided on power cleaning machines, the SeweRodeR, hand tools and all accessories. Water main and culvert cleaning methods are included.

Helpful Design Data For Sewage Ejectors

81. The application and advantages of pneumatic sewage ejectors are outlined in bulletin S-55 of the Blackburn Smith Mfg. Co., Inc., Hoboken, N. J. Included are piping diagrams for electrode and float switch controls plus dimensions and layouts for single and duplex systems. Get your copy by checking the reply card.

For Prompt Service Use The Reply Card

Theory of Controlled Digestion With Floating Cover Tanks

88. In an excellent 40-page booklet, an authoritative discussion of digestion theory and practices, including design, operation and economics is presented by the Pacific Flush Tank Co., Chicago 13, Ill. Complete data are given on the use of floating covers, together with details on tank construction, piping and control chambers.

Manual on Instrument Accessories and Supplies

96. The 60-page loose-leaf book, Catalog 500, includes specifications, part numbers and prices for more than 250 commonly furnished instrument parts and supplies. It is divided into 5 sections: Mechanical; pneumatic; electric-electronic, general, and tools and service. Check the reply card or write The Foxboro Co., Foxboro, Mass., for your copy.

RYNAL PICK UP BROOMS
PLASTIC FILAMENT

- SWEEP CLEANER
- LOWER COST PER MILE
- MORE CONVENIENT
- FEWER BROOM CHANGES
- CUT SWEEPER DOWN TIME
- ADD PRODUCTIVE HOURS TO SWEEPER

SEND US NAME AND MODEL OF YOUR SWEEPER—WE WILL QUOTE RYNAL CHANGE OVER COST—NO OBLIGATION

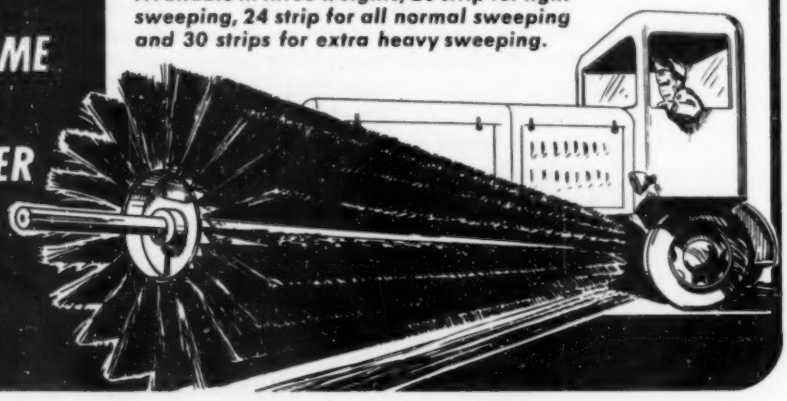
RYNAL CORPORATION
114 ST. JOSEPH ST. • ARCADIA
CALIFORNIA

RYNAL brooms *outwear natural fibres many times* . . . make available, plastic filaments, bonded in steel strips, produced by skilled craftsmen, using automatic machines.

. . . Packed in neat cardboard cartons, ready to slip into the RYNAL core. The end result is a long wearing broom, uniformly filled and well balanced.

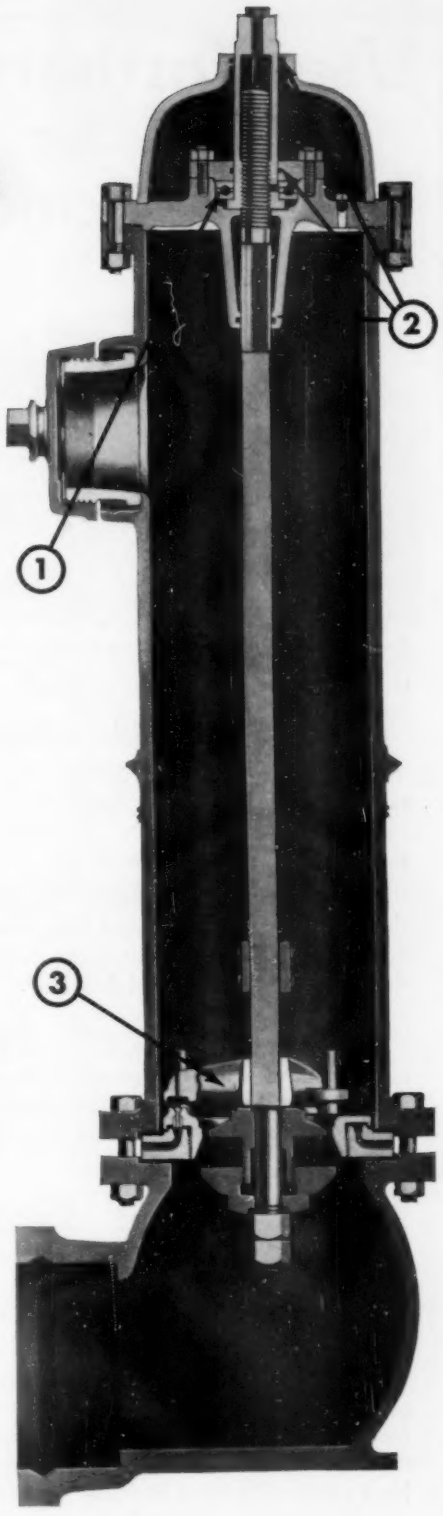
. . . Insure you against broom loss in coiling and material loss in storage.

Available in three weights, 20 strip for light sweeping, 24 strip for all normal sweeping and 30 strips for extra heavy sweeping.



How DARLING B-50-B Hydrants

cut risk and expense!



THE new Darling B-50-B is proving in city after city that it is today's truly outstanding hydrant—the easiest and least expensive to maintain . . . and the most dependable in meeting year-around conditions as they really *are!* Of the various features that contribute to such performance, here are three of major significance . . .

1. BALL BEARING DESIGN. It takes less than half the usual force to open and close this hydrant! Operation is easy, smooth, fast and *sure,* regardless of weather extremes.

2. "O" RING SEALS. This is a packless, *dry-top* hydrant! No stuffing box . . . no packing gland adjustment or maintenance . . . no bothersome lubrication or replacement of packing. Operating threads and bearings *stay* lubricated . . . and not a drop of water ever reaches them. No *opportunity* for trouble!

3. POSITIVE DRAINAGE, WITH AUTOMATIC FLUSHING. This effective, multi-port drainage feature makes freeze-ups virtually impossible. Drain valves are always open when the main valve is closed. During first several turns in opening and last several turns in closing, drain ports remain open temporarily, flushing ports under full line pressure.

With these and other superior design features, Darling B-50-B Hydrants offer exceptional surety in both performance and economy. It will pay to make them *your* choice. They are available in types and sizes for every normal and unusual requirement. Write for Bulletin 5710.

TRADE DARLING MARK

DARLING VALVE & MANUFACTURING COMPANY

Williamsport 22, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

Use Northern Gravel for Rapid Sand Filter

Above is the Grand Rapids, Michigan Filtration Plant. W. L. Harris, the Water Plant Supervisor says: "The Northern Gravel Co. has given us excellent service during the more than 20 years that it has supplied our filter media needs. Our laboratory tests have indicated that its products may be depended upon to meet our specifications."

Filter Sand Specifications

are carefully laid out. The Effective Sizes and Uniformity Coefficients used by Consulting Engineers and also recommended by the American Water Works Association are the result of long years of research and experience.

The Northern Gravel Company is equipped to give you prompt shipment whether it be one bag or many carloads, exact to specifications. Filter sand can be furnished with any effective size between 0.35 MM and 1.20 MM.

Chemical Quality

of the filter sand is also important. It must be hard, not smooth, and free of soluble particles. This requires perfect washing and grading facilities. We have every modern device for washing, drying, screening and testing.

Filter Gravel

supporting the Filter Sand Bed must be, in turn, properly graded to sizes calculated to support the Filter Sand, and be relatively hard, round and resistant to solution.

Northern Gravel has no equal in facilities and our reserves of both sand and gravel are inexhaustible. Northern Gravel Company has been in business over 40 years. We guarantee uniformity of products and our records enable us to duplicate your requirements on short notice. Our location is central and we have commodity rates in every direction.

Northern Gravel Company
Muscatine, Iowa

Box 307 Ph.: Amherst 3-2711

Protective Lining for Concrete Pipe and Structures

131. T-Lock Amer-Plate is a tough, long-lasting acid-resistant vinyl sheet lining for concrete pipe and structures which are exposed to corrosive materials. T-shaped ribs pressed in the sheet are embedded in the concrete as it is poured to lock the lining permanently in place. Get full details from Amercoat Corp., South Gate, Calif.

Sewer Design Flow Chart Based on Manning Formula

154. A large-scale, convenient flow chart based on the Manning formula, together with typical examples of use, is available from Johns-Manville, 22 East 40th St., New York 16, N. Y. To get your copy check the reply card or write to the manufacturer and ask for Bulletin TR-94A.

A Short Course In Pipe Jointing

169. The story of rubber couplings for clay and concrete pipelines is graphically presented in the booklet "Pipe Enterprise", published by Hamilton Kent Mfg. Co., Kent, Ohio. Detailed description of pipe jointing methods; photos showing jobs where Tylox gaskets met the need for easily assembled permanently tight joints installed under all conditions; and a report on the development, manufacture and outstanding features of the compression type gasket make this booklet valuable to every engineer and contractor. Check the reply card.

Engineering Data On Gravity Filter Design

170. The complete line of gravity filters and related accessories furnished by the Permutit Co., New York 36, N. Y., is covered in a well-illustrated 24-page booklet. Each element of a filter and filter controls are discussed in detail to assist the designer of these important units. Check the reply card.

Catalog on the Flynn and Emrich Incinerator Stokers

180. This catalog describes the Flynn and Emrich Incinerator stokers as to design, feeding capacities and loadings. Plenty of drawings of the stokers and photographs of incinerator plants under construction and in operation are included. Also, there is a good section on the incinerator history. Check reply card for catalog No. 1702 from Flynn and Emrich Co., Holiday and Saratoga Sts., Baltimore 2, Md.

Efficient Underdrains for Rapid Sand Filters

239. Be sure you have engineering data on vitrified clay underdrains, efficiently designed for filtering and backwashing. Check the reply card or write F. B. Leopold Co., Inc., Dept. PW., 227 So. Division St., Zelienople, Pa.

Modern Methods and Materials For Jointing Sewer Pipe

402. In a compilation of reprints and related supplementary material, the Atlas Mineral Products Co., Mertztown, Pa., presents a comprehensive review of all types of sewer jointing materials and methods. You will find this interesting and informative reading.

Portable, Standby Or Continuous Power

440. Generators and power plants for emergency, portable continuous power are described fully in literature available from Katolight Corporation, Box 89-107, Mankato, Minnesota. Information on motor generator sets, high frequency changers and independent generators up to 400 K. W. is included.

Data on Adjustable-Speed Magnetic Drives for Low-Lift Pumps

465. A catalog is available from Electric Machinery Mfg. Co., Minneapolis 13, Minn. that tells all about E-M Vertical Synchronous Motors and Magnetic Drive Units. Engineers check the reply card for information on this equipment for sewage pumps.

Reinforced Concrete Pipe For Culverts and Sewers

672. Elliptical Lo-Hed and Hi-Hed pipes, round pipe and flat base pipe are described fully in literature from American-Marietta Co., Concrete Products Div., 101 East Ontario St., Chicago 11, Ill. Headwall details, discharge curves, hydraulic capacity tables and hydraulic properties are included. Check the reply card.

The New TENNANT *VACUUMIZED* SWEEPER

Now...a new way to sweep up ALL* the dirt

NO DUST! NO WATER!

You've never seen streets as clean as when they've been swept by the revolutionary new TENNANT *Vacuumized* Sweeper.

Powerful pickup. Cleaning a 7'4" path and travelling at speeds to 15 mph, this new TENNANT Sweeper instantly picks up practically *all* the dirt. Virtually nothing escapes its powerful broom-and-vacuum system.

** Particles as fine as 5 microns (far smaller than the human eye can see) are caught by huge 540 sq. ft. filter.*

No dust, no water. Since there's no dust nuisance where the TENNANT Sweeper is at work, all need for water spray is eliminated.

Works in tight places. Compact design with short 9'2" turning radius lets the TENNANT Sweeper work easily in parking lots, alleys, bridges, tunnels, and other congested areas.

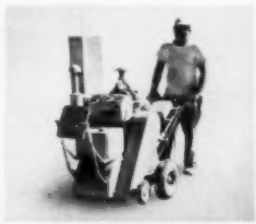
For complete specifications and performance data, write G. H. Tennant Co., 755A N. Lilac Drive, Minneapolis 22, Minn.

TENNANT

VACUUMIZED SWEEPERS

Power Sweepers

Traffic Line Erasers



Concrete Routers

SPECIALIZED MAINTENANCE EQUIPMENT

TYPICAL GUTTER before sweeping. When trying to pick up litter like this, conventional sweepers must spray with water or else kick up clouds of dust that annoy the public. Water, too, is a nuisance, and can't be used in below-freezing temperatures.

ORDINARY SWEEPERS seldom pick up all the dirt. They often leave unsightly litter trails like the one shown above, or mud streaks which soon dry and turn to dust. This is why city officials have long sought a sweeper that would do a cleaner, more efficient job.

NO DIRT HERE! It's been Tennant-swept! The Tennant Sweeper's powerful vacuum-connected brooms get the dirt most sweepers miss. For the first time, your city can now have really clean paved areas—those you can be proud of. No dust clouds, no mud streaks, no water tanks, no hydrant stops.

Get the facts

The new TENNANT *Vacuumized* Sweeper has stirred excitement wherever shown. Its outstanding dust control, maneuverability, and efficiency offer a completely new concept in street sweeping. If you are interested in raising the cleaning standards of your city, it will pay you to investigate this new *Vacuumized* Sweeper.

To order these helpful booklets check the reply card opposite page 50.

Engineering Data Manual on Underground Lift Stations

218. This manual includes descriptive bulletins, specifications covering typical installations for pump type or ejector type stations, friction loss tables covering capacities and size of pipe, pump and motor selection charts and wiring diagrams. Check the reply card or write Smith & Loveless, Inc., Water and Sewage Equipment, P. O. Box 8884, Kansas City, Mo.

Complete Sewage Treatment Unit for Small Cities

528. The application of the Aerator-Clarifier in completely meeting sewage treatment requirements for flows up to 0.5 MGD, which utilizes a number of automatic controls permitting part-time supervision is described in a 16-page bulletin, carefully prepared to provide essential design data. Bulletin 129 issued by the Chicago Pump Co., 622 Diversey Pkwy., Chicago 14, Ill., may be obtained by checking the reply card.

Data on Heavy-Duty Bar Screens

658. Schematic drawings, engineering data and photos of applications of bar screens are covered in a bulletin from Chain Belt Co., Milwaukee 1, Wisc. Check the reply card for information on these mechanically cleaned bar screens.

•

STREETS AND HIGHWAYS

Highway Signs Made of Fir Plywood

40. Specification and procurement, design data, case histories and reference data of fir plywood signs are the sections covered in this file of Bulletins available from the Douglas Fir Plywood Association, Tacoma 2, Wash. Check the reply card.

Bitumuls Paving Handbook Full of Useful Data

23. The latest edition of the Bitumuls Paving Handbook covers a wealth of practical data on paving methods and materials, road and airport paving specifications and construction details, complete tabular data on asphaltic binder applications and aggregate requirements, condensed Asphalt Institute specifications plus data on Laykold compounded asphalts for flooring, tennis courts, protective coatings and waterproofing. You can have a copy by checking the reply card. American Bitumuls & Asphalt Co., 200 Bush St., San Francisco 20, Calif.

How to Prepare and Maintain Roadways With Calcium Chloride

65. "The Calcium Chloride Road," is the name of a new 24-page two-color catalog issued by the Columbia-Southern Chemical Corp., 632 Fort Duquesne Blvd., Pittsburgh 22, Pa. Included are sections on dust control, gradation, placing and mixing materials and shaping. General information on spring, summer and fall maintenance is also provided. Check the handy reply card.

What Should You Look For In a Power Sweeper?

206. Helpful information to aid you in the selection of a power sweeper to fit your needs is provided in Bulletin 85.2, issued by G. H. Tennant Co., 755 No. Lilac Drive, Minneapolis 22, Minn. Full data on the highly maneuverable Tennant Model 75 Sweeper is included. Get your copy by checking the reply card.

Trenching Equipment Data Conveniently Assembled

212. The entire line of Cleveland trenching and backfilling equipment is now covered in a single bulletin, with material arranged for quick comparison of capacities, specifications and dimensions of all models. Twenty-four action photos graphically illustrate various job applications. Get Bulletin S-120 now for easy review of your trenching equipment needs. Just check the reply card or write to the Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio.

Three-Horizontal Red Traffic-Signal

244. A new three horizontal red traffic signal is described fully in literature available from Southern Signals Inc., 222 Beach St., Shreveport, La. Maximum controlled intensity, greater range of readability and maximum coverage are features. Check the reply card today.

Illustrated Specifications on Brush and Limb Disposal

222. A new booklet on the modern approach to the brush problem shows how an Asplundh chipper reduces bulky branches and brush trimmings to chip size for mulch or easy removal. Write Asplundh Chipper Company, 505 York Road, Jenkintown, Pa., or use the handy reply card.

"A Complete Package" of Road Building Equipment

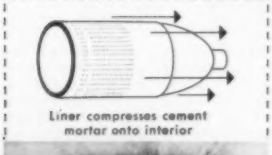
261. A new catalog describing the road widener, trench roller and base paver has been released by Blaw-Knox Co., Construction Equipment Division, Pittsburgh 38, Pa. Illustrations, specifications and operation procedures are fully covered. Check the reply card today.

How to Get Better Grader Operation

111. A most interesting and instructive 20-page illustrated action booklet on how to operate a motor grader is now available from Galion Iron Works & Mfg. Co., Galion, Ohio. Designed to help operators get more effective use from the versatile motor grader, this booklet covers the hydraulic system, steering, tips on leaning wheels, proper blade positioning, turning, gear speeds and operating procedures. Colorful, easy-to-read presentation guarantees good readership. Check the reply card for your copy.

How Accurate Boring Speeds Underground Pipe Installations

135. Interesting charts showing earth boring costs, speed and accuracy for holes from 2½" to 14½" diameter and up to 80 feet long are included in 16-page Catalog No. 8 issued by Hydrauger Corp., 681 Market St., San Francisco 5, Calif. Specifications and general operating instructions are also covered.



Tate Process applies cement mortar lining to the interior of 4" to 16" lines quickly and economically . . . while the lines stay "in place." Permanently restores full flow coefficients. Reduces pumping and maintenance costs. Protects against corrosion, contamination.

Write for full information TODAY!

Specializing in Pipe Protection Problems • Tate and Centriline "In Place" Interior Cement Mortar Lining • "In Plant" and "Railhead" Centrifugal Spinning of Cement Mortar or Coal Tar Linings — Somastic® Exterior Coating • Pipe Wrapping • Reclamation: Removal of Old Wrapping, Straightening, Blasting, Beveling, Testing.

PIPE LININGS
A Division of American Pipe and Construction Co.
2414 East 223 St. (P.O. Box 457)
Wilmington, California

JUST ONCE IN A LIFETIME! you acquire a

WARREN-KNIGHT Instrument

Practically eliminated during an entire lifetime of service are repairs and maintenance to a Warren-Knight Transit-Level. The design and construction of these superb instruments is so superior and so different that it is prudent to investigate them, if you are in the market. After all, an instrument that promises probable total elimination of repairs and maintenance — and will probably never be replaced during your entire remaining professional career — certainly offers you a dramatic saving.

FREE 10 DAY TRIAL — So sure are we of your reception to this magnificent instrument that we offer it FREE for 10 days trial test on your own work sites. You will find that over 40 superior advantages will save you time and effort. Prove for yourself the full facts concerning this unique instrument.

Ask for Bulletin P-81 that lists Full Details.

WARREN-KNIGHT
136 N. 12th St., Phila. 7, Pa.

4:30 p.m.
Conditions hazardous

5:15 p.m.
Rush hour traffic moves safely

COLUMBIA CALCIUM CHLORIDE

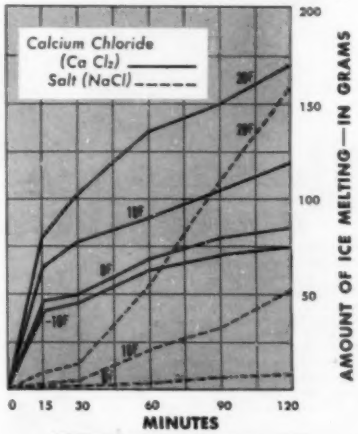
makes streets and roads safe faster

Speedy ice and snow control keeps towns and highways running smoothly, holds fatalities and injuries down. And here are new test results proving once again that Columbia Calcium Chloride brings safety to surfaces *faster*. This skid-proofing chemical melts *8 times as much ice* within thirty minutes after application as is melted by salt. Here are comparative results over a two hour period: ▶

Better order an ample supply of Columbia Calcium Chloride today through your nearest Columbia-Southern District Sales Office.

AMOUNT OF ICE MELTED
15 TO 120 MINUTES

350 Grams ice in 7" by 11" pan
40 Grams chemical (based on 100% NaCl or $CaCl_2$)



NOTE: NO reaction with salt at —10 F.

Columbia Calcium Chloride is available in both High Test Flake (94-97% $CaCl_2$ content) and Regular Flake (77-80% $CaCl_2$).

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte
Chicago • Cleveland • Boston • New York
St. Louis • Minneapolis • New Orleans
Dallas • Houston • Pittsburgh • Philadelphia
San Francisco

IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division

Safeguard Winter Traffic with Columbia Calcium Chloride

DON'T GUESS!

use an ACKER SOIL SAMPLING KIT for accurate sub-surface information

With accurate sub-soil information, you avoid costly trouble later on. And, what better way to get this information than with a portable, easy to use Acker Soil Sampling Kit. For here is a versatile collection of twelve soil sampling tools packed in a handy steel kit that can be carried in any car.

Write today for prices and Bulletin 26 PW.

Acker Soil Sampling Kit being used for test borings for bridge foundation. Over 30 years of soil sampling experience make this Acker kit the most useful you can buy!

ACKER DRILL CO., Inc. 725 W. Lackawanna Avenue Scranton, Penna.

a complete line of Diamond and Shot Core Drills, Drilling Accessories and Equipment

why take chances?

use

TAYLOR COMPARATORS

for

Fast, Accurate pH, CHLORINE, FLUORIDE Tests to insure precise control

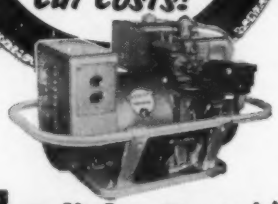
Fast, on-the-spot tests for pH, chlorine, fluoride made with Taylor Comparators help you to quickly and accurately determine the exact amounts of chemicals needed to control coagulation, chlorination, fluoridation and corrosion. Easy, colorimetric tests are made in minutes. Place treated sample in middle tube. Move color standard slide across until sample matches one of the standards. Read values right from slide. Complete water analysis only a little more detailed with the Taylor Water Analyzer.

COLOR STANDARDS GUARANTEED

Be sure to use only Taylor reagents and accessories with Taylor Comparators to assure accurate results. All Taylor liquid color standards carry an unlimited guarantee against fading. SEE YOUR DEALER for Taylor sets or immediate replacement of supplies. Write direct for FREE HANDBOOK "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes complete Taylor line.

W. A. TAYLOR AND CO.
7304 YORK RD. • BALTIMORE-4, MD.

WRITE FOR NEW FOLDER! Let KATOLIGHT Cut Time! Cut Costs!



Katolight Portable POWER PLANTS

With instant, dependable electrical power on the job, work speeds up . . . costs go down. Katolight Portable Plants give your crews "plug-in" electricity anywhere, whenever they want it . . . power to operate all types of electrical tools or for steady, bright flood lighting. Sizes and models for every portable standby or continuous use from 350 watts to 100 KW. Up to 500 KVA on request.

WRITE FOR NEW LIGHT-WEIGHT PORTABLE POWER PLANT FOLDER

KATOLIGHT CORPORATION
BOX 891-107, MANKATO, MINNESOTA

How to Solve the Brush Disposal Problem

277. Fitchburg Chippers, engineered to solve the brush disposal problem reduce troublesome brush and trimmings to tiny, easy to-dispose-of chips. Several models are available to meet your needs. May be mounted on truck body or on trailer, tractor or jeep. Full details in interesting, profusely illustrated 16 page bulletin. Write Fitchburg Engineering Corp., Fitchburg, Mass.

New Acker Vane Shear Tester

367. A bulletin describing a new inexpensive accurate technique for obtaining "in-place" shear readings of soils is available from Acker Drill Co., Inc., Scranton 3, Pa. The shear test kit has a complete set of vane test tools for testing soils to depths of 100 ft., and operating information on this kit is covered in Bulletin 700, available by checking the reply card.

Self-Propelled Ditching Machines

438. Information on a self-propelled one man operated ditching machine, model 524 T, model W-2 and a new midget ditcher, model 4 T, for light construction is now available from the Vermeer Mfg. Co., Pella, Iowa. The Model 524 T digs 8 to 24 inches wide and down to 6 feet deep, while the model 4 T digs 6 to 14 inches wide and down to 4½ feet deep. Model W-2 Ditcher digs from 2" wide up to 4" down to a depth of 30". Full data on these ditchers available by checking the reply card.

Sherman Power Digger For Digging in Any Soil

493. Sherman Major power digger literature is now available, providing details on this new hydraulic backhoe designed specifically for attachment to Fordson-Major tractors. The unit can dig to a depth of 12½ ft. and can dig through a 180 arc of swing and to a loading height of 8 ft. 8 in. Specifications and operation are fully covered. The 8-page colored catalog can be obtained from Sherman Products, Inc., 3200 West 14 Mile Road, Royal Oak, Mich., or by checking the handy reply card.

Use The Reply Card

Warning Lights and Barricade Units

569. A complete catalog on warning lights, flashing lights and barricade units is available from Neo-Flasher Mfg. Co., 3210 Valhalla Drive, Burbank, Calif. Models, types and prices are included. Check the reply card.

Reflectorized White or Yellow Crosswalk Markings

578. Crosswalk markings of Perma-Line, the quick setting line that is easily applied, trouble-free, economical, and which outlasts paint 4 to 6 times, is described in literature of the Veon Chemical Corporation, 22-09 Bridge Plaza North, Long Island City 1, N.Y. Available in reflectorized white or yellow. Tests under your local conditions are invited. Get details by checking the reply card.

Vacuum Cleaner and Leaf Collector For Cleaner Streets

595. A unit is now available that can be mounted on a right-hand drive jeep or a pick-up truck for picking up gutter trash and leaves. Complete specifications, capacity, operation and installation procedures are covered in a bulletin available from Tarrant Mfg. Co., Saratoga Springs, N. Y., or can be obtained by checking the reply card.

Construction Methods for Salt Stabilized Roads

609. A comprehensive booklet showing modern methods of salt stabilization is available from the Morton Salt Co., 120 So. LaSalle St., Chicago 3, Ill. Stabilized secondary roads, base courses and shoulders are discussed and all equipment and construction methods are covered. Just check the reply card for your copy.

Aggregate Spreaders For Highway Construction

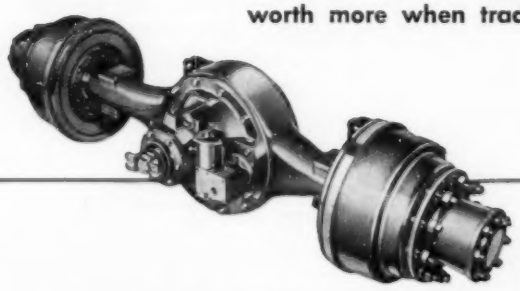
719. Aggregate spreaders that are designed to be propelled by crawler tractors are described fully in literature available from Tractor Spreader Co., 630 Terrace Ave., Hasbrouck Heights, N. J. Units permit a flow of material for spreads from 10 to 16 ft. wide and 1 to 16 ins. deep. Check reply card.

In the Road Building Industry—

Eaton 2-Speed Axles Keep Trucks on the Job —Cut Operating and Maintenance Costs

Pulling out-of-the-hole in off-the-highway operation, making time on the hills, maneuvering in heavy traffic, highballing on the open road — each calls for a different gear ratio to assure maximum efficiency, economy, and safety. Eaton 2-Speed Axles *double* the number of available gear ratios, permitting the driver to use the one best suited to road, load, and traffic conditions. This use of the *right* gear ratio for every situation permits engines to run in their most efficient and economical speed range, reducing stress and wear on all power-transmitting parts. Not only do Eaton 2-Speed Axle trucks make more and quicker full-load trips, but they do it at lower operating cost and with less maintenance; they stay on the job and out of the shop. Even under the roughest conditions, trucks equipped with Eaton 2-Speeds last thousands of miles longer — and they're worth more when traded in.

More than Two Million Eaton Axles in Trucks Today. For complete information, see your truck dealer.



EATON — AXLE DIVISION — MANUFACTURING COMPANY
CLEVELAND, OHIO

PRODUCTS: Engine Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Hydraulic Pumps Motor Truck Axles • Permanent Mold Gray Iron Castings • Forgings • Heater-Defroster Units • Automotive Air Conditioners Fastening Devices • Cold Drawn Steel • Stampings • Gears • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

3 FAST RUGGED LOW COST

Pow-R-Ditchers

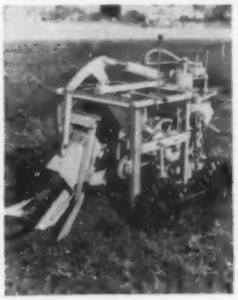
A Model For Nearly Every Need

Model 524T Pow-R-Ditcher

Lowest priced BIG ditcher on the market! Digs 8"-24" wide at speeds of 1'-15' per minute. One man operation. Ideal for contractors, municipalities, utilities, etc.

Model 4T Pow-R-Ditcher

The Vermeer "Midget Ditcher" digs 6"-14" wide and is only 6' high, 13' long, 48" wide. Easily transported on a pick-up truck. Very maneuverable and ideal for footings, cable, gas, water and sewage lines.



Model W-2 Pow-R-Ditcher

Smallest of the Pow-R-Ditchers, the W-2 digs 2½"-4" wide and 3' deep. For gas service, electrical service and shallow water lines.

Write For Literature and Low Prices on the Complete Vermeer Pow-R-Ditcher Line

Thousands of Pow-R-Ditchers used from coast to coast. Learn what low ditcher prices really mean! Write for name of nearest dealer.

VERMEER MANUFACTURING CO.

1439 W. WASHINGTON • PELLA, IOWA

CONSTRUCTION EQUIPMENT AND MATERIALS

Frameless Buildings Will Simplify Your Building Problems

89. A 6-page bulletin on frameless steel buildings is available from Armco Product Information Service, Middletown, O. The buildings come in a wide range of sizes, are quickly erected and provide permanence and neat appearance. Check the reply card today.

Check List for Successful Earthmoving Bids

147. Valuable information for the earthmoving contractor and for the engineer who must estimate earthmoving costs is provided in a new two-color illustrated booklet issued by Caterpillar Tractor Co., Peoria, Ill. A convenient check list is included to help select the proper equipment for the job. Check the reply card to get Form No. DE502.

Heavy-Duty Pipe Cutter Works In or Out of Trench

164. Built to stand the most severe service, the all-purpose Ellis & Ford pipe cutter, for cast iron water mains 4" through 12", is easy to use in tight places, works in or out of trench. Full details on cutter and interchangeable parts in Catalog 39, available by checking coupon. Ellis & Ford Mfg. Co., Ferndale 20, Mich.

Handbook of Castings For All Public Works Construction

220. Every type of construction casting needed by engineers and contractors in the public works field will be found in a 136-page catalog issued by Neenah Foundry Co., Neenah, Wis. Detailed illustrations and complete tables of dimensions will help the designer and materials buyer.

Eaton 2-Speed Axles For Your Trucks

264. Truck axles that provide easy shift, supply positive lubrication and have a self-contained air brake are available from Eaton Mfg. Co. For complete information on these rugged axles check the reply card or write Eaton Mfg. Co., Cleveland, Ohio.

Booklet Shows Design of Pre-Engineered Steel Buildings

271. Pre-engineered Butler steel buildings are available in every size, type and design to meet your building needs. In a helpful 16-page booklet you will find details on several basic designs and an unlimited variety of door, window and interior treatments; answers to your questions on construction and erection; and many illustrations of typical uses. Use the reply card or write to Butler Mfg. Co., Kansas City, Mo.

Davis Back-Hoe and Davis Loader

312. Literature is available from Massey-Ferguson Industrial Division, Massey-Harris-Ferguson, Inc., 1009 S. West St., Wichita, Kans., describing the new Davis backhoe and Davis loader. The back-hoe can dig at right angles and to a depth of 13 ft. and detaches in 5 minutes. Both units are available for most popular makes of tractors.

Restoration and Protection Of Concrete Structures

385. A "How to Do It" bulletin describing the Thoro System for repair and sealing interior and exterior masonry surfaces is available from Standard Dry Wall Products, Inc., New Eagle, Pa. The treatment for every water problem is presented in illustrated case histories in this useful publication.

The Trucks You Need for Every Public Works Job

461. Extra life and operating economies are built-in features of every Ford truck model. There's a chassis size and engine for each of your needs, from light utility work to heavy-duty construction jobs. Get latest literaure from Ford Motor Co., Truck Div., Dearborn, Mich., by checking the reply card.

Complete Bulletin On Municipal Supplies

473. Everything from leak locators to street signs is listed in the big 108-page bulletin "Municipal Supplies" published by Darley. Hundreds of different items for all city departments are included. Get your copy of Bulletin No. 155 from W. S. Darley & Co., 2814 Washington Blvd., Chicago 12, Ill., by checking the reply card.

Catalog on John Deere Tractors and Equipment

588. Information and specifications on the John Deere "420" crawler and wheel-type industrial tractors are fully covered in catalog from Deere & Co., 3300 River Drive, Moline, Ill. Attachments such as snow plow blades, rear-mounted blades, mowers and angling dozers are described. Check the reply card.

Crawler and Wheel Tractors

636. A handy pocket bulletin that describes Oliver crawler and wheel tractors has been released by The Oliver Corp., 400 W. Madison St., Chicago 6, Ill. Check the reply card for specifications on the tractors and their attachments.

Hoists For Trailer Dump Bodies

664. Fifty-seven hoist models and complete information covering specifications, applications and capacity ratings for hoists applicable to both single axle and tandem axle semi-trailers are covered in literature from The Daybrook Hydraulic Div., Young Spring & Wire Corp., Bowling Green, Ohio. Check the reply card.

Slide Rule PS1 Calculator For Concrete

713. A new pocket size slide rule calculator for the testing of concrete in compression is available from Forney's Inc., P.O. Box 310, New Castle, Pa. It is designed to convert instantly the pressure applied to concrete cylinders and blocks into psi.

Overhead Jobs, Painting, Tree Trimming Done By Strato-Tower

720. The Strato-Tower comes in 4 sizes 35', 45', 65', 95' and has a 280° rotation. For complete details and prices write Strato-Tower Division, Elkhart Welding and Boiler Works, Inc., Elkhart, Ind., or check the reply card.

SNOW AND ICE CONTROL

Uniform Salt Spreading Saves Material

42. The wide, thin pattern provided by Tarco "Scotchman" spreaders avoids salt waste, saves time and labor. Get Folder BL for full details on their spreader and table of material application rates. Use reply card or write Tarrant Mfg. Co., Dept. PW, Saratoga Springs, N. Y.

How to Make Icy Surfaces Safe

455. A bulletin on how calcium chloride works in ice control and directions for its use has been made available by Wyandotte Chemicals Corp., Wyandotte, Michigan. Other uses of calcium chloride are fully outlined.

WEED AND DUST CONTROL

Weeds Controlled by Using Simazin 50W

318. General weed control is accomplished by using Simazin 50W and water. For full information on this new pre-emergence herbicide and how to use it write Geigy Agricultural Chemicals, P. O. Box 430, Yonkers, New York. Check the reply card.

City of Sidney, Ohio

Gets Smooth Measurement of Sludge Magnetically!

. . . WITH FOXBORO MAGNETIC FLOW METER

"The Foxboro Magnetic Flow Meter on return activated sludge went into operation so smoothly that no one paid any attention to it. They haven't done a thing to it since, and it's still operating smoothly."

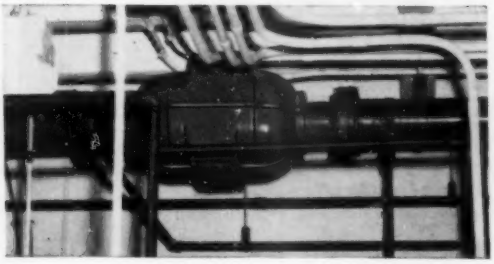
That's the comment of W. D. Sheets of Ohio State University, Technical Adviser for the new Sidney, Ohio, sewage plant. It's a typical perfect-performance report on the Foxboro Magnetic Flow Meter, a modern flow meter that's always easy to install, simple to operate, practically maintenance-free.

No line restrictions — no pressure taps to plug up. With the Magnetic Flow Meter, there's nothing in the line to cause pile-up of solids. And you can forget about purging of pressure taps — there aren't any! Electrical cable carries measurement signal to remote Dynalog* Electronic Recorder, providing a direct magnetic measurement of fluid velocity. Get full details on this unique development in flow meters. Write for Bulletin 20-14A. **The Foxboro Company, 261 Norfolk St., Foxboro, Mass., U.S.A.**

*REG. U.S. PAT. OFF.

FOXBORO REG. U.S. PAT. OFF. ***FIRST in FLOW***

All Flow measurements are recorded by Foxboro Instruments centrally located in the plant director's office of the Sidney plant. Shown below, left to right, are: Air Flow Recorder with integrator; Sewage Flow Recorder with integrator; Dynalog Recorder for return activated sludge.



This compact, troublefree Foxboro Magnetic Flow Meter is installed right in the return activated sludge line at Sidney, Ohio's modern new sewage plant. There's nothing in the line to obstruct flow in any way . . . no pressure taps or purges.

To order these helpful booklets check the reply card opposite page 50.

STREET LIGHTING AND TRAFFIC CONTROL

Investigate These Street Lighting Standards

54. You can get complete data on Kerrigan factory-built "Weldforged" street lighting standards, brackets and mast arms by using the handy reply card. Check these strong, well designed, inexpensive steel standards for practical street and highway lighting. Handsome 26-page folder includes data sheets on floodlighting and area lighting applications. Kerrigan Iron Works, 1033 Herman St., Nashville, Tenn.

Bulletin Gives Tips on "Light-Up Celebration"

82. A bulletin designed to aid municipal officials, civic groups and utilities in planning celebrations to mark the installation of new street lighting systems is now available from the General Electric Co., Schenectady 5, N. Y. Bulletin GEA-6462 provides a 5-step plan for organizing an effective light-up celebration. Check the reply card.

Engineering Data on Aluminum Lighting Standards

256. Latest designs and applications of all-aluminum, seamless, tapered lighting standards, traffic signal posts and elliptical lighting brackets plus detail drawings and mechanical specifications are provided in a comprehensive 16-page bulletin issued by Pfaff & Kendall, 84 Foundry St., Newark, N. J.

A Guide to Effective Traffic Safety

468. A 20-page catalog with hundreds of illustrations of all types of signs used on highways and in motor and pedestrian traffic areas is offered to public works officials by Traffic and Street Sign Co., 84 Foundry St., Newark 5, N.J. This convenient reference covers all your sign needs.

Traffic System Computer & Selector

260. Electro-Matic Master Equipment is fully covered in Bulletin E-222 just released by Automatic Signal Div., Eastern Industries, Inc., Norwalk, Conn. This system provides coordinated signal control responsive to traffic changes as they develop and it continually evaluates and adjusts to volume and direction of traffic.

REFUSE COLLECTION AND DISPOSAL

How New, Larger Load-Packer Cuts Refuse Collection Costs

51. Ever increasing problems in refuse collection work include longer hauls and higher costs of labor, chassis, operation and maintenance. As a soluition, Gar Wood offers Load-Packers with dual-thrust compaction that gives big capacity on shorter wheelbase, plus safe, labor-saving operation. Profusely illustrated Form W-144 tells why you should investigate Load-Packers. Check reply card or write Gar Wood Industries, Inc., Wayne, Mich.

Use The Reply Card

Increasing the Efficiency of Bulk Rubbish Collection

177. Strategically spotted bulk containers can be handled by one man operating a Dempster-Dumpster equipped truck. Get full details of this cost-saving system of rubbish collection, as used by many cities to increase efficiency and eliminate unsanitary conditions. Write Dempster Brothers, Inc., 952 Dempster Bldg., Knoxville 17, Tenn., or use the handy reply card.

Engineering Data on Incinerator Design

118. A comprehensive bulletin which provides full engineering data on municipal refuse incineration is offered by Pittsburgh-Des Moines Steel Co., 3422 Neville Island, Pittsburgh, Pa. This 20-page booklet shows basic requirements for satisfactory incineration, gives incinerator design details and describes modern mechanical stoking, construction features and modernization of existing plants. Get your copy by checking the reply card.

General Specifications for Refuse and Garbage Trailers

251. Two bulletins, one on the Pak-Mor 38 cu. yd. tandem axle trailer unit and the other on the Pak-Mor 32 cu. yd. trailer for use with Model GRD Dempster are available from Pak-Mor Manufacturing Co., Box 6147, San Antonio, Texas. General specifications, power train, operating procedures, maintenance and lubrication and other helpful information are included.

Planning A Sanitary Landfill

287. Covered in this manual is how to work various types of terrain efficiently for sanitary landfills. Swampy land, river bottom land, gravel pits, strip mines, and flat land operation are the sections. Write to Caterpillar Tractor Co., Peoria, Ill., or check the reply card for your copy.

BUSINESS ADMINISTRATION

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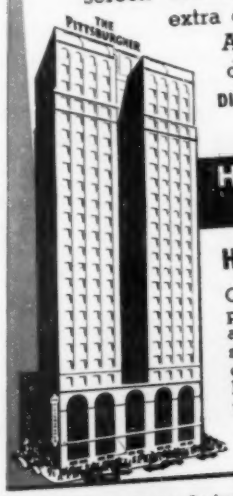

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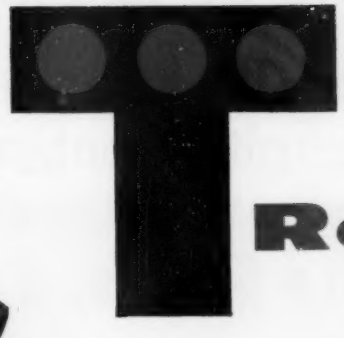

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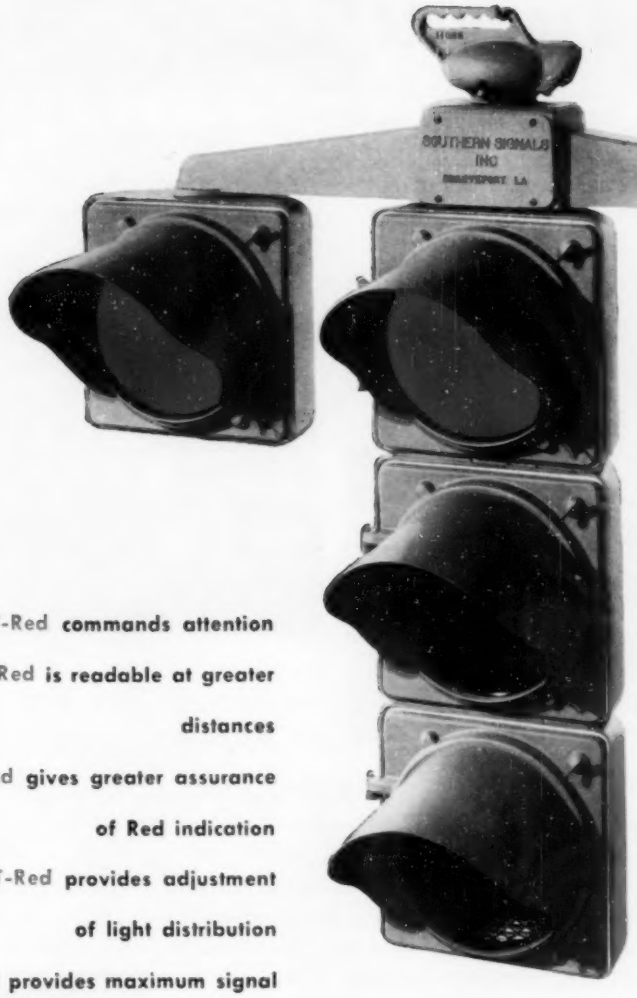

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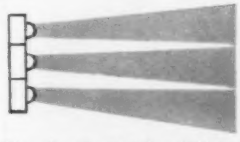

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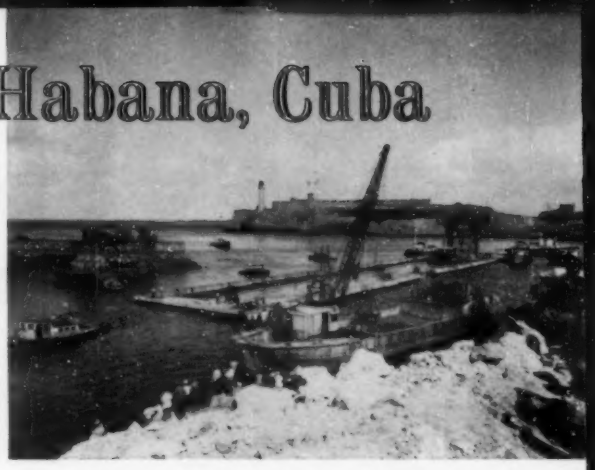
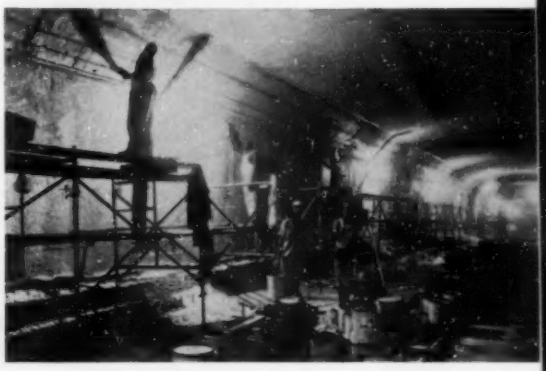


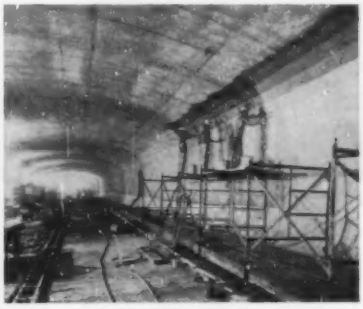
Four-lane, underwater tunnel, connecting Malecon Drive, City of Havana, Cuba with Guanabacoa near the famous Morro Castle, opening the sparsely-populated peninsula to residence and commercial activity.

Design, engineering and construction by Societe des Grand Travaux de Marseilles, Paris, France, 733 Meters Long, 23 Meters Wide, 7 Meters High, cost $28,500,000.00. Waterproofed inside and outside with THORO System products, THOROSEAL, WATERPLUG and THORITE. Two lanes will be opened by December, 1957.

Mammoth precast concrete sections are floated to location by attached pontoons, lowered 24 meters under water and connected to previously-sunken sections. ***Note the famous Morro Castle. Top, center background.***



From Havana side, tunnel entrance grades down to harbor pool level.



Two double-lane tunnel sections take shape; forms will be filled with poststressed concrete.

Precast sections of tunnel, honeycomb patched with THORITE Patching Mortar and entire surface protected with THOROSEAL.

Thoro System Products applied, completes the job!

Preparing interior surface for WATERPLUG and one brush and one trowel coat of THOROSEAL. All walls, floors and ceilings are sealed with THOROSEAL.

THOROSEAL is being applied to all interior surfaces. Over 800 drums of WATERPLUG have already been used, where water was entering and where sections were joined together. All honeycomb and construction faults were sealed with THORITE Patching Mortar, before lowered to position in the bay.

Thousands of drums of THOROSEAL, WATERPLUG and THORITE Patching Mortar are being used on this vast project, which will be completed in February, 1958.

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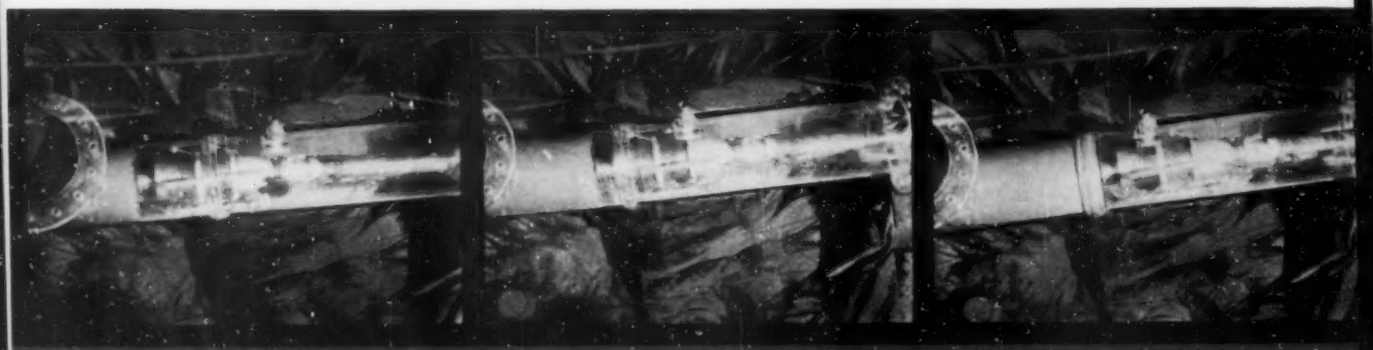
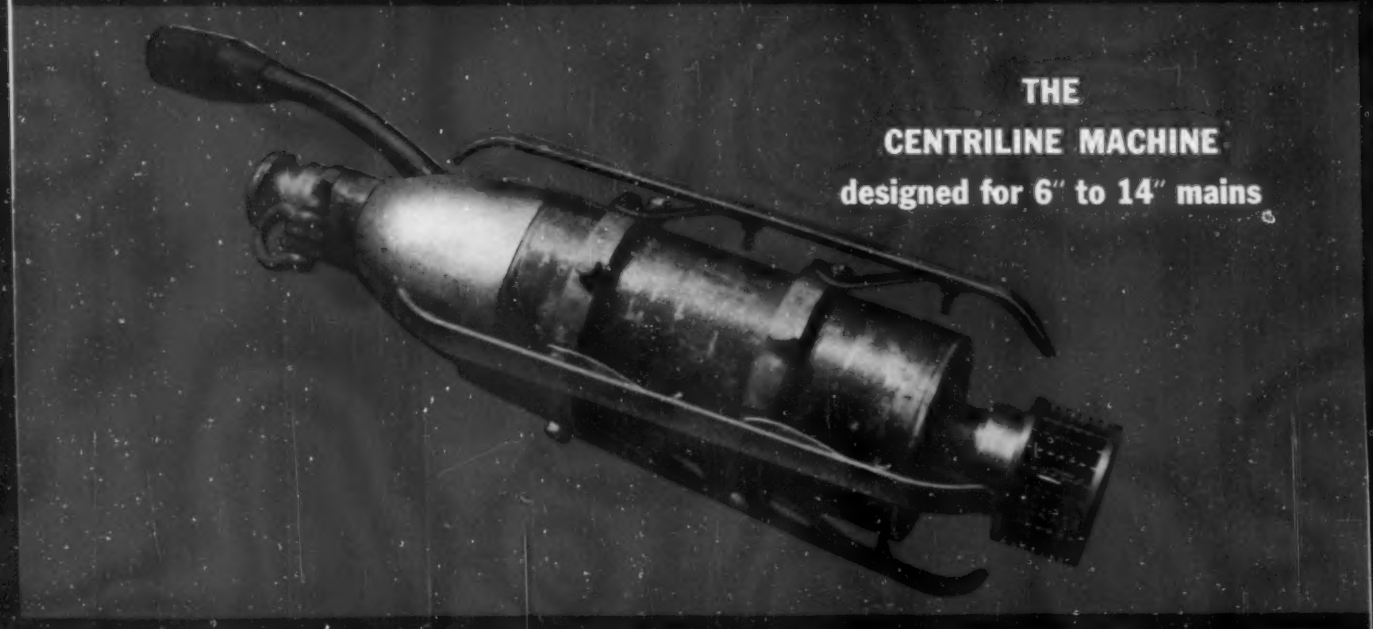


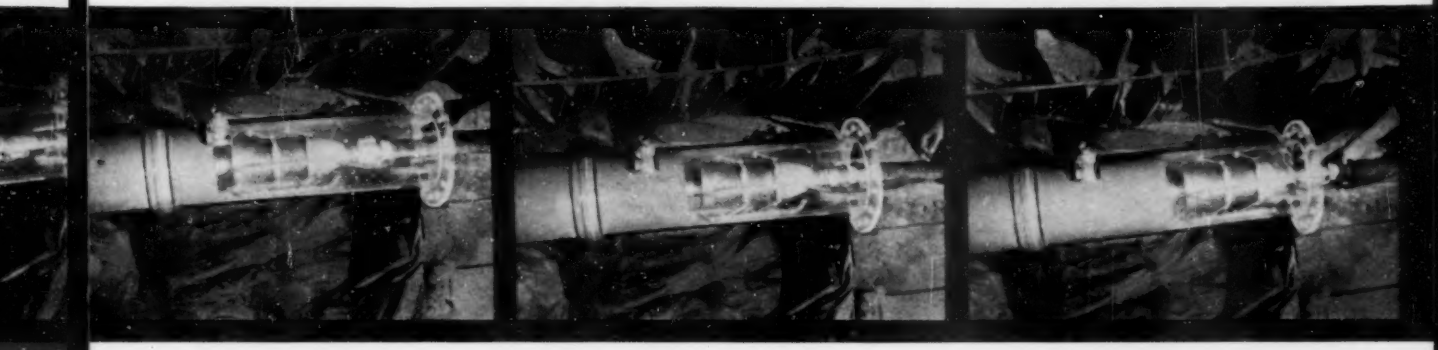


STRIP PHOTO • TOP: *Cross section view, in special transparent pipe, showing new small size Centriline machine in action being pulled through the pipe from left to right. Note the uniformity of the cement-mortar lining.*

STRIP PHOTO • BOTTOM: *View of machine at work in special cut away pipe illustrating centrifugal application of the cement-mortar.*

in the water works field in the past 15 years!

is also available for 6″ to 14″ mains



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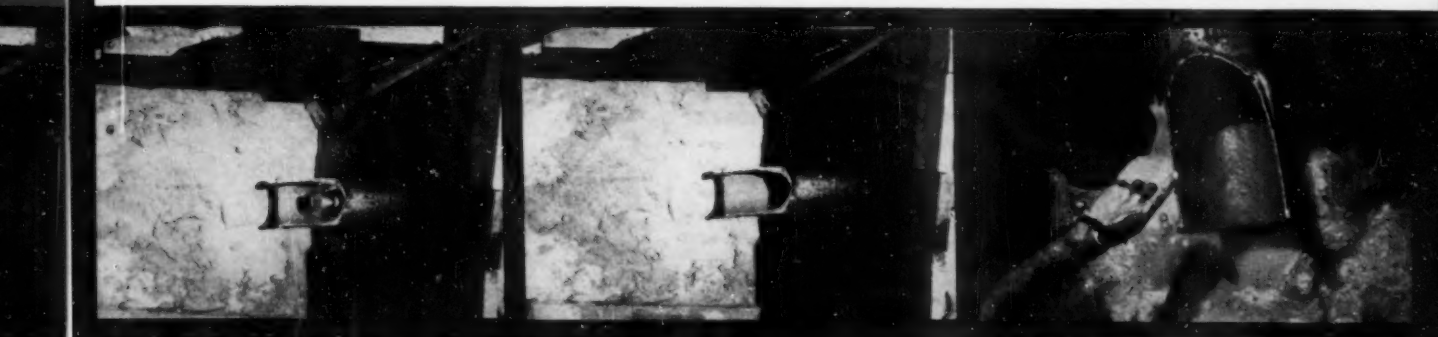

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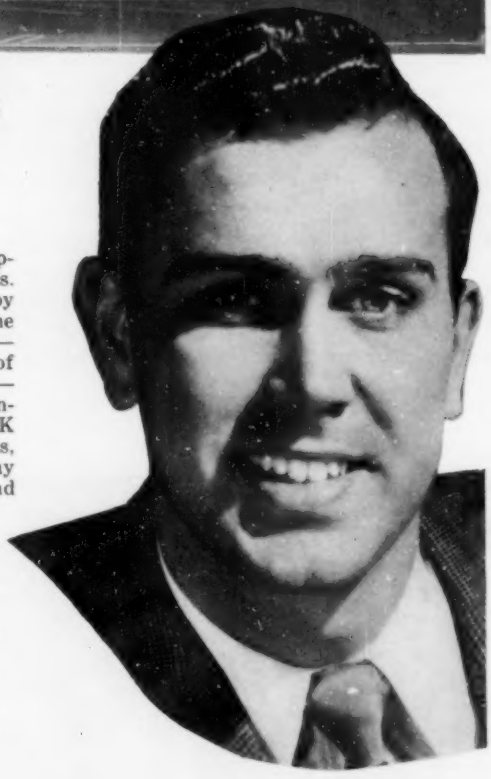

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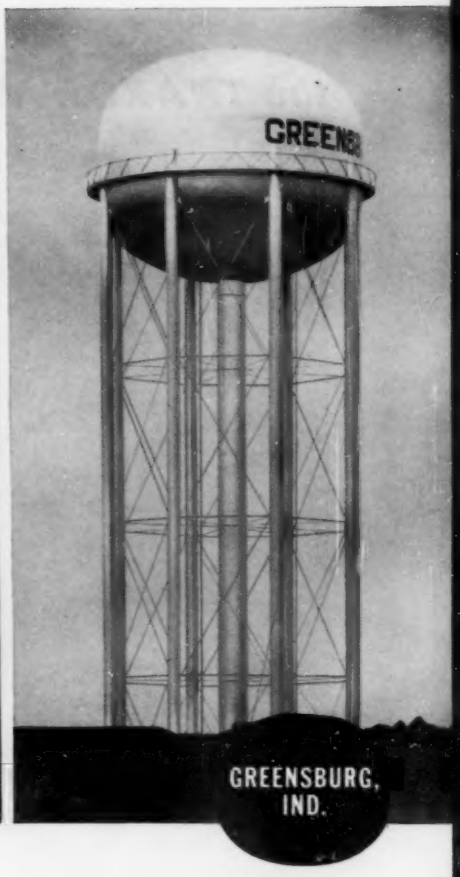

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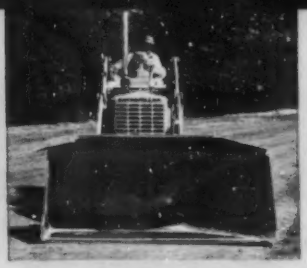
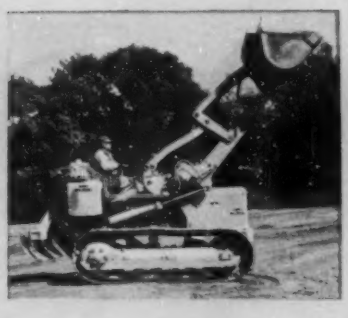
Here  comes...

the TRAXCAVATOR'S  new...

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A NEW DIMENSION IN LOADER VERSATILITY

PUBLIC WORKS

January 1958 Vol. 89 • No. 1

FIELD SAMPLING OF CONCRETE

H. R. CRAIG,
Engineer of Construction,

HAROLD KRAUSER,
Field Engineer of Construction,

JOSEPH UNGER,
Division Eight Testing Engineer,
Ohio Highway Department

BEFORE DISCUSSING practices and equipment used in the field sampling of concrete in Ohio, a short resume should be given of the various kinds of coarse and fine aggregates and cement that are used. Three types of coarse aggregates are used: 1) Gravel; 2) limestone; and 3) slag.

Gravel quality in some instances is impaired by the presence of a considerable quantity of soft pieces, but this condition is overcome by the use of soft stone eliminators which discard the objectionable material. Limestone is found in practically unlimited quantity and the quality is good. Air-cooled blast furnace slag is available in the areas near steel mill operations.

Two types of fine aggregates are used: natural and limestone sand. Each is in plentiful supply in the areas where their companion coarse aggregate is found.

Three types of cement are permitted in concrete: 1. Air-Entraining Portland Cement; 2. High-Early-Strength Air-Entraining Portland Cement; and 3. Air-Entraining Portland Blast-Furnace Slag Cement.

Two sizes of coarse aggregate are used as follows:

In the No. 3 aggregate all material should pass a 2-in. sieve; 80-100 percent passes 1½-in. sieve; 20-60 percent passes a 1-in. sieve, 0.5 percent passes a ⅜-in. sieve. In the No. 4 aggregate all should pass the 1-in. sieve; 80-100 percent should pass the ¾-in. sieve, 20-60 percent passes a ½-in. sieve; 5-30 percent passes a ⅜-in. sieve; and 0-5 passes a 0.187-in. sieve.

Each size must be weighed separately and combined in such a manner that the No. 4 aggregate represents from 35 to 50 percent by weight of the total coarse aggregate. Within these limits, the percentage of each size used may be varied to give the most desirable and uniform gradation of the combined aggregate materials.

Either natural or manufactured sand composed of clean, hard, durable particles of stone is used provided it meets the gradings shown in Table 1, next page.

The cements must meet the requirements set forth in ASTM designations as follows: 1) Air-Entraining Portland Cement, C-175 Type 1A; 2) High-Early-Strength Air-Entraining Portland Cement C175 Type 111A; and 3) Air-Entraining Portland Blast-Furnace Slag Cement C205 Type 1S-A

Samples of both coarse and fine aggregates from the proposed source of supply are required to be taken at least seven days before the material is to be used. A composite sample representing each 1500 cubic yards of coarse aggregate or 500 cubic yards of sand is taken and sent to the Ohio State Highway Testing and Research Laboratory for analysis. The "quartering" method for selecting the material to be tested is used. Under this method, after a representative sample has been obtained, the material is spread in an even circular layer upon a smooth, clean surface and is divided into quarters. Two opposite quarters are discarded, and the sample is formed by combining the two remaining quarters. Samples of coarse aggregate weigh between 50 and 60 pounds while those of fine aggregate weigh between 30 and 40 pounds.

The sampling of cement, in practically all cases, is performed at the producing plant by regular plant

● **SLUMP TESTS are made at the beginning of any concrete pour and at other times when appearance of the concrete indicates that its consistency has changed.**

inspectors who draw the samples from bins which have been previously designated as those which will contain, exclusively, cement that is to be used on State Highway projects. Each half-gallon sample can represent no more than one car or 500 barrels.

Concrete Classes

Four classes of concrete—"C", "D", "E" & "F"—are used. The following proportions for all classes are set forth. It should be remembered that the weights of aggregates shown are based on average specific gravities. Correction factors applicable to individual projects are sometimes necessary.

In Class "C" concrete the minimum cement content per cu. yd. is 6.5 sacks with the maximum net water content in gallons per sack of cement being 5.75. Used are 165 lbs. of fine and 305 lbs. of coarse gravel; or 180 lbs. of fine and 285 lbs. of coarse limestone; or 195 lbs. fine and 235 lbs. of coarse slag.

Table 1—Sand Grading

Screen Size	Percent Passing		
	Natural	*Manufactured*	
3/8"	100	100	...
No. 4	95-100	90-100	100
No. 8	70-95	65-95	90-100
No. 16	45-80	40-80	50-75
No. 30	25-60	20-60	30-60
No. 50	10-30	10-40	14-30
No. 100	1-10	0-10	4-12

In Class "D" concrete the minimum cement content is 6.5 sacks and the water content 5.5 gals. Used are 160 lbs. of fine and 325 lbs. of coarse gravel; or 180 lbs. of fine and 300 lbs. of coarse limestone; or 195 lbs. of fine and 245 lbs. of coarse slag.

In Class "E" concrete the minimum cement content is 5.5 sacks and the water content 6.75 gals. Used are 200 lbs. of fine and 380 lbs. of coarse gravel; or 225 lbs. of fine and 350 lbs. of coarse limestone; or 245 lbs. of fine and 290 lbs. of coarse slag.

In Class "F" concrete the minimum cement content is 4.75 sacks and the water content 7.5 gals. Used are 230 lbs. of fine and 445 lbs. of coarse gravel; or 260 lbs. of fine and 410 lbs. of coarse-limestone; or 280 lbs. of fine and 340 lbs. of coarse slag.

The sampling of concrete aggregates and the determination of the weights of the various ingredients of a concrete mix is entrusted to men who are specifically trained, both by instruction and experience, and who are designated as "Concrete Control Inspectors." These men, who work for and are responsible to the Project Engineer, according to the Manual of Instructions issued by the Testing and Research Laboratory, "are responsible for the production of all concrete required for use in the work, for carrying out of all requirements of the Specifications relating to concrete design and control, and for the making of all required tests and determinations."

The duties assigned to Concrete Control Inspectors are three-fold: 1. Concrete design and control; 2. sieve analysis of aggregate; and 3. sampling and testing concrete.

It is considered that the following listed equipment is necessary for the Concrete Control Inspector to perform these duties: 1 - Stove for drying aggregate; 1 - scale with weights; 1 - ⅝-inch tamping rod; 1 - counter scoop; 1 - piece canvas 5-ft. x 5-ft.; 1 - slump cone; 1 - trowel; 1 - one-third cubic foot measure; and 1 - field sieve set with 2, 1½, 1, ¾, ½, ⅜, ¼-in. and No. 4, 8, 16, and 50 sieves. The rocker box of this set has a capacity of ½-cu. ft. Also needed are 4-bread pans, 1-clip board, 1 - scratch tablet for calculations; laboratory addressed envelopes; concrete inspector's daily reports—TE-45; concrete sample tags and cards—TE-18; general sample tags and cards—TE-31; concrete beam reports—TE-38; maximum and minimum thermometer: cement thermometer; cylinder molds; beam molds; concrete spade; and beam testing machine.

Minutely detailed instructions are issued to each Concrete Control Inspector which outline the procedures to be followed in order properly to fill in the daily report. It is intended to present and record a complete analysis of the concrete used.

In the performance of their third duty—sampling and testing concrete—the first operation consists of making slump tests. These tests are made at the beginning of any concrete pour and at any other time when the appearance of the concrete indicates that its consistency has changed. It is of the utmost importance that the slump be closely controlled and kept within the limits set forth in the Specifications.

In making a slump test the following procedure is necessary: The concrete used for the slump test shall be truly representative of the batch. Excessively wet, dry, or segregated areas, if any, should be avoided in selecting the sample.

The slump cone shall be placed on a clean, flat, non-absorbent surface, such as a smooth plank, and the Inspector shall hold the mold firmly in place, while it is being filled, by standing on the foot pieces. The mold shall be filled in three layers, each approximately one-third the volume of the mold (the first layer approximately 3 inches thick, the second 4 inches, and the third 5 inches). In placing each scoopful of concrete in the cone, the scoop shall be moved around the top edge of the cone as the concrete slides from it, in order to insure symmetrical distribution of concrete within the cone. Each layer shall be rodded with 25 strokes of the tamping rod. The strokes shall be distributed in a uniform manner over the cross-section of the mold and shall penetrate into but not through the underlying layer. The bottom layer shall be rodded throughout its depth. After the top layer has been rodded, the surface of the concrete shall be struck off with a trowel so that the mold is exactly filled. The mold shall be removed immediately from the concrete by raising it carefully in a vertical direction. The slump shall then be measured immediately by determining the difference between the height of the mold and the height at a vertical axis of the slumped concrete.

Probably the next test performed by the Inspectors on the mixed concrete is the determination of the yield. When the volume of concrete to be mixed is small, one test is considered to be sufficient. For medium size pours, two tests are required for each day's work. For large pours, at least three tests are essential.

Yield Test

The various operations involved in making a yield test are as follows: Fill the 1/3 cubic foot measure with concrete from a batch or batches representative of that being placed in the forms, in approximately three equal layers, rodding each layer with 25 strokes of the tamping rod before the next is placed. When the rodding has been completed, the measure should be jarred slightly to preclude the possibility of honeycombing. Strike off the excess concrete and finish with a trowel just even with the edge of the measure. Wipe the outside of the measure clean of any mortar which might be clinging to it and weigh to the nearest 0.01 pound. The weight just ob-

● **YIELD TEST: Details of performing the test are given on the facing page. On small volumes, one test is enough; for medium volumes, two; for large jobs, three.**

tained minus the weight of the empty measure is the weight of 1/3 cubic foot of concrete.

Repeat this operation twice and use the sum of the three concrete weights obtained as the weight per cubic foot of the concrete.

Divide the total actual batch weights of all the ingredients of the batch, that is, weight of cement plus weight of moist sand plus weight of moist coarse aggregate plus weight of the added water, by the weight per cubic foot of concrete determined as described above. The quotient is the number of cubic feet of concrete in the batch.

If the number of cubic feet per batch determined by this test is within 1 percent of the maximum allowed for the specified class of concrete, no change in the batch weights will be necessary. However, if the volume of concrete is more than 1 percent greater or less than the maximum allowed, the batch weights must be reduced or increased, in order to bring the yield to that specified.

Also, a continued and persistent over-or-under-yield, even if within the 1 per cent range, should be corrected.

Percentage of Entrained Air

A test that is performed each time a yield is taken is the determination of the percentage of entrained air. This test should be repeated when there are indications that the air content has changed.

The test procedure using the hook gage method is as follows:

1. Determine the weight per cubic foot of the concrete using the 1/3 cubic foot measure, and empty and clean the measure.

2. Using the weight per cubic foot of the concrete taken to the nearest whole pound, the weight of the sample will be 1/8 as great. For example, if the weight of the concrete is 138 lbs. per cubic foot, the weight of the sample will be 17.25 lbs.

3. Into the clean container, weigh the amount of concrete, representative of the batch.

4. Jar the concrete vigorously to remove entrapped air.

5. Place the hook gage on the measure. Carefully, without disturbing the concrete, fill the measure with water to the hook gage point. The water may be poured into the cupped hand held close to the concrete.

6. Remove the hook gage from the measure, and using a tin can (a No. 2½ will do) which has been dipped into clear water to wet it thoroughly, take out of the measure approximately one quart of water, setting it aside for later use.

7. Stir the concrete and water thoroughly with the wetted tamping rod until it is believed that all entrained air has been removed. Ordinarily this point has been reached when the stirring becomes very difficult. Utmost care must be taken that no water or concrete is lost during the stirring operation!

8. Replace the hook gage and carefully, without spilling, replace the water removed in (6).

9. Weigh carefully to the nearest 0.01 pound approximately one pound of water in the can.

10. After the concrete and water have set for approximately five minutes, carefully bring the water level in the measure to the hook gage point, using the water weighed up in (9).

11. Reweigh to the nearest 0.01 pound the can and remaining water.

12. Remove the hook gage and without removing any water from the container, carefully stir the water and concrete with the wetted rod for at least 30 seconds. Replace the hook gage and add water to the gage point from the can. Reweigh the can. If the water added as a result of this operation exceeds 0.01 pound, repeat until the amount of water necessary to bring the level back to the gage point does not exceed 0.01 pound.

13. Subtract the final weight obtained in (12) from the weight obtained in (9) and multiply the difference by 12.8. The result is the percentage of entrained air.

● **ENTRAINED Air: Determination of the percentage of entrained air is made each time the yield test is made. Test procedure details are given above and at right.**

● TEST CYLINDERS are made daily for each 2,000 sq. yds. of surface or base and for each 100 or 50 cu. yds. of concrete in bridges, depending on span length.

14. These calculations are made on Inspector's copy of TE-45 "Concrete Inspector's Daily Report", and the percentage of entrained air thus determined entered in the designated place under "Remarks" on the copies of TE-45 sent to the Laboratory.

A second method used for the determination of entrained air is by the Press-UR-Meter Method. This method is not used on slag concrete except under the direct supervision of Laboratory technicians.

The equipment needed to perform this test consists of a 0.25 cubic foot capacity bottom pot, a top which includes a gage, pump and clamp, a calibration cylinder, two sections of tubing—one straight one and one curved, a strike-off bar, a ⅝-in. bullet point tamping rod, a rubber syringe and a wooden carrying case for the equipment.

The method of operation is as follows:

1. Fill the pot in two layers with a representative sample of fresh concrete, rodding each layer into place.

2. Shake and jar the pot to remove entrapped air from concrete.

3. Strike off the concrete surface, level full, using the straight edge. Clean edge of pot thoroughly.

4. Place the top on the pot and clamp securely, with both petcocks open.

5. Using the rubber syringe, inject water through one petcock until all air is expelled through the opposite one. Leave petcocks open.

6. With built-in pump, pump up air to "initial pressure" line on gage. This initial pressure line is given on the paper in the carrying case lid.

7. Wait a few seconds for compressed air to cool to normal temperature and then stabilize the gage hand at the proper initial pressure line by pumping or bleeding off as needed.

8. Close both petcocks and press down on "thumb lever" to release air into the base. Hold thumb lever down for a few seconds, lightly tapping the gage with the finger to stabilize the hand on the dial.

9. Read and record the percent of air as shown on the gage. This is the apparent air content of the concrete in percent.

10. The true percentage of air entrained in the concrete is the apparent air content, as found previously, minus an aggregate correction factor. Therefore, subtract the aggregate correction factor from the apparent air content found in (9) and record on Concrete Inspector's Daily Report as percent of entrained air in concrete.

Determination of Aggregate Correction Factor

Since aggregate particles are generally porous they contain a small amount of air which is included in the apparent air content and must be deducted to obtain the true entrained air content of the concrete. To obtain this aggregate correction it is necessary to run an air determination (with the meter) on equivalent amounts of sand and each size of coarse aggregate that would be contained in a pot full of concrete. This factor varies with different aggregates and must be determined by actual tests.

11. The amount of each of the aggregates to be used in the test is determined by multiplying the actual batch weight, as used in the mix, by the ratio of the volume of the pot to the total yield from the batch. This is pot volume (0.25 cu.

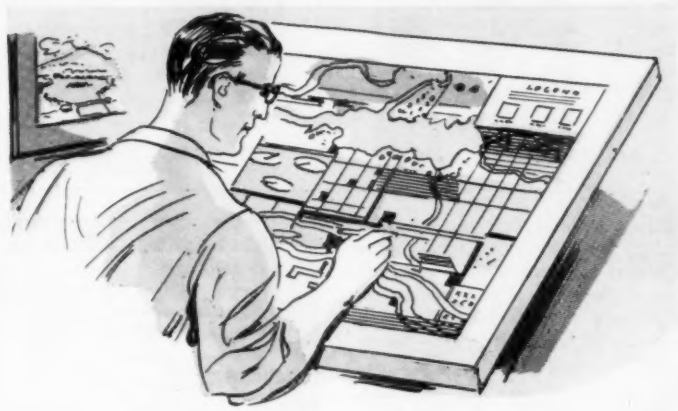
(*Continued on page* 150)

● TEST BEAMS: Two or three test beams, using pavement or base concrete are made for each 2,000 sq. yds. placed.

● BEAMS are tested at 3, 5 or 7 days for ordinary concrete and at 1, 2 or 3 days for the high-early-strength.

WHAT A CITY CAN DO
to Foretell a Water Shortage

KARL F. HOEFLE,
Forrest and Cotton,
Consulting Engineers,
Dallas, Texas



OFTEN ONE sees in the press, accounts of some city experiencing a "water shortage" when in fact there is no shortage. Failure of treatment facilities and/or distribution systems to keep up with increasing demands have created a situation resulting in sub-standard pressures or curtailment of service. The consumer is suffering from a shortage. Generally he makes no distinction and is not so much concerned with the reason. But he is vexed and often vocal. Nevertheless there is a distinct difference in the two situations. A shortage in supply is usually of much greater gravity, much more expensive and time-consuming to overcome than inadequacy of treatment works or distribution facilities.

Some fortunate communities are favorably situated near large natural lakes or streams of considerable perennial flow. They have never experienced a lack of supply and can foresee none. But it is a different story for those communities which depend upon impounded supplies or upon diminishing underground waters. The rapid urbanization of this country during the past two decades has imposed severe loads on all public water systems. Many a community with an apparent safe water reserve has been treated a startling view of large areas of lake bottom at its storage reservoirs. Or it has seen its water table drop and has drilled more and more wells of progressively reduced yields.

Faced with such a situation, the operator has two problems. First, he has to bring his entire system back into comfortable balance, with ample supply and facilities to meet all demands. Secondly, and equally important, he must devise and put into practice procedures which will forewarn him of impending shortage.

It is possible for a water works to so chart its course as to be warned of impending shortage of supply in time to prepare against it. The only tools required for this purpose are good records.

The operation of a water works system is a business dealing both in service and a commodity. Like any other business it must have accurate accounting of the units of commodity processed and sold. Good management, therefore, requires all water be measured. And, in order that process uses and system losses be known, it is essential that it be measured more than once. It is not sufficient to multiply the running time by the name plate rating of the pumps to determine daily pumpage. Such information may be highly misleading and is useless when system improvements or enlargements are to be designed. Raw water pumped to the treatment plant should be metered by standard recording meters equipped with 24-hour, or continuous strip charts. Water used in the treatment process and for filter washing should also be metered. Net water produced and pumped to the distribution system should be metered by standard recording meters equipped with 24-hour charts, and lastly, all water sold should be metered. The latter should include all water which by custom, policy or ordinances may be free of charge to parks, municipal buildings and institutions, hospitals or schools.

These data should be summarized each month or billing period, and annually, in convenient and usable form. They should be religiously kept as a permanent record of the utility. The information developed therefrom, among other things, will show: The monthly and annual drafts upon supply; net changes in reserve; total pumpage to treatment plant; net pumpage to distribution system; total water sold; average daily, maximum and minimum rates of pumpage; average, maximum and minimum rates of consumption; maximum hour demand and average daily per capita consumption.

Hypothetical Case

To illustrate the use of such records to chart a future course, let us consider the mythical small city of Blankville, which had a population in 1950 of 26,800. The water supply is from an impoundment on Blank Creek. The drainage area above the reservoir is 55 square

Table 1—Water Usage in Blankville

Year	Population	Average Pumpage		Max. Day	Max. Hour
		mgd	gpcd	mgd	mgd
1940	21,350	2.71	127	5.40	9.89
1945	24,500	3.25	135	6.43	11.86
1950	26,800	3.86	144	7.73	14.09
1955	30,200	4.65	154	9.29	16.97
1960	33,650	5.45	162	10.90	19.89
1965	37,900	6.37	168	12.74	23.25
1970	42,200	7.39	173	14.60	26.25

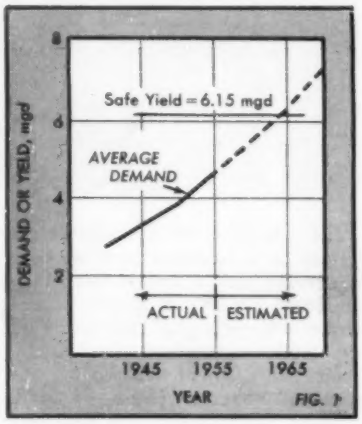
Table 2—Inflow at Blankville Reservoir, Acre-Feet

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1904	234	388	490	2,128	1,001	892	439	351	132	88	88	980	7,211
1905	1,616	3,386	4,549	6,114	15,052	6,875	9,413	2,399	278	329	1,719	3,891	55,621
1906	8,725	2,743	2,487	4,725	2,011	2,041	622	1,134	532	790	227	2,267	28,304
1907	3,306	775	1,763	1,009	4,995	4,344	541	117	74	117	2,209	4,220	23,470
1908	2,684	4,096	2,245	1,828	10,225	2,977	263	366	417	307	212	468	26,088
1909	388	1,117	973	497	256	205	71	40	29	80	80	475	4,211
1910	497	702	1,082	1,580	1,061	263	271	51	37	95	29	88	5,690
1911	161	161	256	1,514	536	96	490	132	80	2,494	80	644	4,630
1912	973	556	3,891	5,383	1,529	293	263	2,808	380	176	95	161	16,427
1913	483	841	3,964	1,997	585	241	2,092	161	1,126	497	380	5,749	20,113
52-Yr. Av.	2,856	2,765	3,054	3,634	4,325	2,536	820	447	297	567	1,119	1,665	24,085

miles, and the reservoir has a capacity of 21,500 acre-feet. It has been determined to have a safe yield of 6.15 mgd through a recurrence of the critical period of record. If the records outlined above have been kept, Table 1 can be derived.

Data in this table for 1960 and subsequent years are estimated from the preceding history. They indicate that before 1965 the average daily demand will exceed the reliable yield of the reservoir. The demand, past and estimated future, has been plotted in graph form on Figure 1 against the safe yield. The two lines intersect in 1963. From that year forward this reservoir would not supply the demand through a recurrence of the critical period. To guard against that hazard an additional source must be ready to supply water by 1964 at the latest, and preferably before then. It is never known in advance, when a protracted period of deficient runoff will begin. Although our graph indicates that the demand cannot be supplied after 1963 should a drouth occur, normal or better runoff might be experienced for a number of years beyond 1963. In the meantime the demand is rising. When, then, the inevitable lean years do appear, and no additional supply has been provided, the increased demand will quickly deplete storage. If on the other hand, additional storage has been provided it will have been filled and ready for use. To be safe then, the warning indicated must be heeded and additional storage must be provided, even though subsequent events might show that the expense could have been postponed.

With such a picture before him the engineer can make plans in ample time to forestall a shortage. The time required to make engineering studies, construction plans, financial arrangements, construction time and reservoir filling time, subtracted from 1963 will fix the latest date he can start.

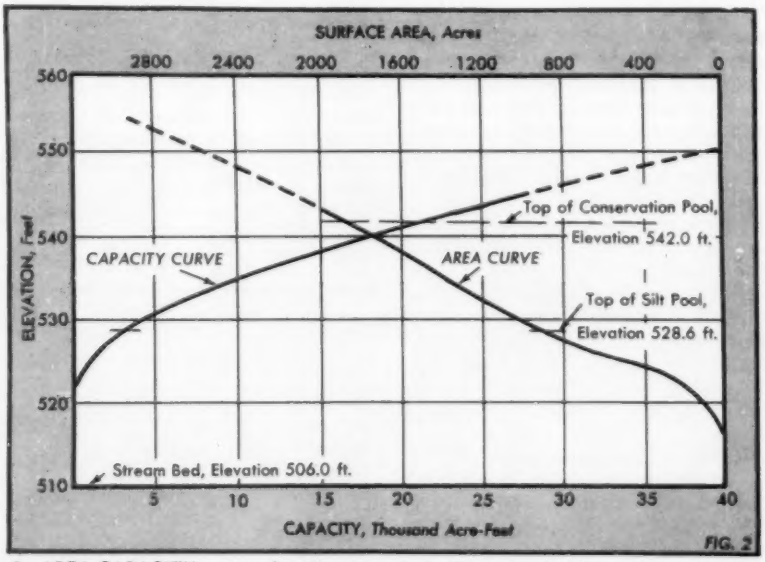


● **DEMAND vs. safe reservoir yield.**

But, suppose neither the capacity nor the safe yield of a reservoir is known, how does one proceed? First, the holding capacity of the reservoir must be determined. A topographic map of the reservoir bottom must be made, as accurately as may be possible, by surveys and soundings. From this map the capacity may be computed for successive depths up to spillway level by planimetering the areas enclosed by successive contours.

From the map thus prepared and measured a chart may be made on which are two curves, one representing the contents at all elevations of water surface and the other the surface area at all water elevations. The latter will be needed to determine the volume of water lost by surface evaporation as the level rises and falls. Figure 2 is the area-capacity curve of the reservoir.

The area of watershed must be determined. This can often be obtained from maps prepared by and available from the U. S. Geological Survey. If the area has not been mapped by the Geological Survey, it may have been by the Soil Conservation Service. The State or County Highway Department will surely have road maps on which the watershed divides can be plotted by reconnaissance.



● **AREA-CAPACITY curves for the reservoir in the example discussed in the text.**

The watershed yield, or runoff at the reservoir must be obtained from stream gaging records. Stream gaging is conducted by the Geological Survey and results are published periodically as "Geological Survey Water Supply Papers", which may be obtained from the Government Printing office at moderate cost.

It is highly desirable that the gaging record extend back many years so as to disclose the greatest number and magnitude of variations that have occurred in the past. To be most reliable, the gaging station should be on the stream supplying the reservoir, and ideally, just above the reservoir. If there is no gaging record on the stream, then it becomes necessary to base an estimate of runoff on other stream gagings in the vicinity. If such gagings are available on a stream nearby and the two watersheds have no appreciable difference in rainfall or runoff characteristics, then the runoff per square mile may be considered the same for each. If gaging from a distant station must be used then they must be modified to compensate for differences in areas, rainfall, and runoff characteristics of the two watersheds.

The runoff at the reservoir site is computed for each month for the entire series of years and tabulated, the units preferably being acre-feet per month. From this tabulation the length, total runoff, and its distribution during the most critical period is determined. In the case of Blankville, the runoff records, partly derived from distant gagings, extended from 1904 through 1955. A portion of this record is shown in Table 2.

This section of the record spans the most critical period, that from July 1908 through Nov. 1911. The runoff records of this period were used in computing the safe yield of the Blankville Reservoir.

The safe yield is found by placing a demand upon the reservoir and making a reservoir operation, using inflows of the critical period. Several trials are necessary, each beginning with a full reservoir. The annual demand used is broken down into monthly demands by the ratios of monthly to annual demand established from the plant records. When that demand is found which just depletes the reservoir at the end of the critical period, that is the maximum safe yield during a recurrence of the critical period.

The same result may be had by beginning with an empty reservoir, making an operation back through the critical period to its beginning. The amount of water in the reservoir at the end of the operation will be the storage required to insure a safe yield equivalent to the draft used in the operation. Plotting the result, the intersection of the draft abscissa with the ordinate denoting the storage will mark one point on a yield curve. Additional operations using other demands will establish other points on this curve, which within limits, will establish the relationship between reservoir capacity and yield. The intersection of this curve with the ordinate denoting the previously found reservoir capacity will indicate the reservoir's maximum safe yield. Such a yield curve for the Blankville Reservoir is shown on Figure 3.

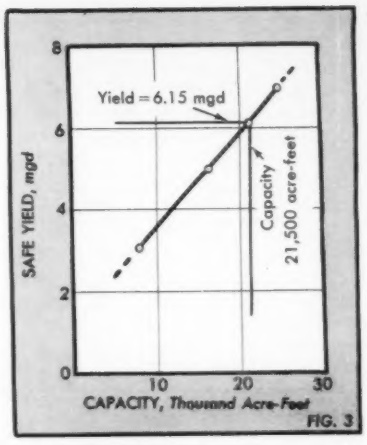


FIG. 3

● **INTERSECTION shows max. yield.**

In making such reservoir operations the demand placed upon the reservoir is usually not the only reservoir loss to be considered. In some cases it is obligatory to make releases to satisfy downstream water rights. Such required releases must be taken into account, as must the losses due to evaporation. If the annual rainfall in inches during the critical period equals or exceeds the evaporation in inches, then evaporation losses may be ignored. Otherwise the loss due to evaporation will be a third reservoir loss to be considered in the operation. The net loss only need be considered, net loss being the excess of evaporation over rainfall, in inches. This loss must be determined for each month. Evaporation data may be obtained from the U. S. Weather Bureau and from some state agencies. To determine the quantity of water lost by evaporation during each month the average surface area of the reservoir during the month is multiplied by the net evaporation loss in feet, resulting in acre-feet lost to evaporation.

While the process of determining the safe yield of a reservoir, as just described, is not a complicated one, when all basic data are readily available, it becomes a problem calling for experience and trained judgment in the great majority of cases. It should not be attempted by one having no prior experience in the adaptation and use of hydrologic data. The employment of an engineer of known competence in this field for such a determination is the part of wisdom.

MINIMUM WATER USE RECORDS TO BE KEPT

Part of System	*Type of Record and Frequency*
INPOUNDED SUPPLY	**Daily stage**
	Inflow — Daily or other period
	Withdrawal — Daily
	Amount in storage — Daily
	Weather record — Daily
WELLS	**Static level**
	Pumping level
	Max. sustained yield — Periodic tests
	Daily pumping record
	Weather record — Daily
PRODUCTION	**Total pumpage — Daily**
	Net pumpage to distribution system — Totals and 24-hr. charts
	Pumping pressures — 24-hr. charts
DISTRIBUTION	**24-hr. record of contents of all storage tanks**
	Daily consumption — Net pumpage ± net change in storage on system
	Number of active consumer meters used monthly
	Total metered water to consumers by billing periods
	Population served — Monthly or by billing period

THE USE OF ASPHALT EMULSION For STABILIZATION

A. L. McMILLION,

Chief Maintenance Engineer,
West Virginia State Road Commission

IN ORDER to improve and maintain 31,250 miles of rural and urban roads, the State Road Commission of West Virginia would require an annual budget of ninety million dollars for the next twenty years. Unfortunately, this amount is almost double the annual budget of approximately fifty million dollars the State Road Commission now receives.

In view of our limited revenue, it has become increasingly necessary to investigate maintenance and construction methods by which we can obtain the maximum mileage for our allocated funds.

In 1949 the State Legislature provided a bond fund program for the secondary road system. By 1953, we had over five hundred miles of newly constructed traffic bound macadam base roads. The majority of these roads consisted of crusher run sandstone, slag or gravel, comprised of particles of 1½-inch maximum size down to dust. Creek bed or pit gravel, chert and shale were also utilized. After a few years these untreated roads became a terrific drain on maintenance funds, requiring constant grading, draining, and regular annual repairs.

In 1954 we decided to undertake our first major bituminous stabilization projects. The site of the work was in Preston County in the northern part of the state, bordering Pennsylvania, and in Grant-Tucker Counties on Route 90 connecting US #50 and US #219. In 1949 roads were graded and stabilized mechanically with a low grade crusher run sandstone. Laboratory tests on aggregate to be stabilized indicated that 5½ percent by weight of mixing grade of emulsified asphalt would be required to reduce water absorption to within satisfactory limits and provide sufficient aggregate bond to maintain stability under traffic. Various bituminous binders were tested with the aggregates to be stabilized and emulsified asphalt with the addition of approximately 6 percent of water gave better dispersion throughout the mix and much lower absorptions after dehydrating and, therefore, greater stability. Based on these results it was decided to use emulsified asphalt meeting West Virginia Specification SS-1, which was supplied by the American Bitumuls & Asphalt Company.

● **APPLYING emulsified asphalt with P & H single pass stabilizer drawing from tank truck. Emulsified asphalt SS-1; rate 4.0 gals./sq. yd.; depth 6 inches.**

On the 1954 projects mixing was accomplished with two Seaman mixers and two auto patrols. Application of both the mixing water and SS-1 was by pressure distributor followed by initial mixing with Seaman mixers. A minimum of three applications of mixing water and SS-1 was required to obtain the desired mixture and proper dispersion. Additional mixing and aeration were obtained by windrowing from side to side with two auto graders until moisture was reduced to permit initial compaction with sheepsfoot and rubber tire rollers. Following initial compaction the pavement was shaped to grade and cross-section and compacted with a ten-ton three wheel roller. Upon completion of the projects and when the moisture of finished pavement was down to less than five percent, a (50-50) dilution of W. Va. SS-1 and water was applied at the rate of 0.15 to 0.2 gallon per square yard. Thirty minutes to two hours later the work was opened to traffic. No cover aggregate was

used. After thirty days of further curing under traffic a double surface treatment was constructed using 0.5 gallon per square yard of binder and thirty pounds of limestone chips (W. Va. #12) per square yard, thus completing the projects.

The 18-ft. wide projects completed in 1954 totaled 13 miles in length. Aggregates stabilized were crusher run sandstone containing 11 to 19 percent of 200-mesh material and P. I. ranging from 4.5 to 7.5 per cent. Maximum of aggregates was 1½ inches.

Depth of stabilized pavement averaged from 5 to 6 inches using 3.5 gallons of SS-1 per square yard. All work was done by State forces and completed in 45 working days. The average cost was $0.76 per square yard including the seal coat.

In 1955 two additional projects were constructed totaling 10.8 miles. These projects were located in Wirt and Harrison Counties. It was decided to let these projects to contract since the 1954 work done by State forces proved this type of construction feasible and economical. The General Paving Company of Morgantown, West Virginia was low bidder. Total cost of work was $0.78 per square yard without seal.

These projects were constructed similarly to 1954 projects, except that the Seaman mixers used were provided with pumps and spray bars to introduce both water and SS-1 enabling us to get better control of applications. The same type of aggregate was stabilized as that used on original projects in 1954.

Following the curing of stabilized base, State forces applied a double surface treatment similar to the 1954 construction.

Prior to the 1956 program, an inspection of the previously constructed projects was made. The 1954 projects showed some distress in localized areas. It is believed these localized failures were due to poor clay subgrade and poor drainage with insufficient depth of selected road metal, resulting in clay subgrade being incorporated during the mixing operations.

Of the 1955 projects, no failures were had in the Wirt County jobs and only one minor area of about 200 linear feet in Harrison County, due to underground springs below the road and to poor drainage. After cutting shale seams and installation of six inch perforated drains in the ditch line, no other deterioration of pavement was noticeable.

We contracted and subsequently stabilized 15.1 miles of secondary roads with emulsified asphalt in Tyler and Marion Counties, in 1956. General Paving Company again was low bidder with a price of $0.29 per square yard for mixing and manipulation and the State Road Commission furnishing the SS-1. It was decided to increase the quantity of SS-1 to 6.5 percent based on improved laboratory results with this quantity.

Approximately 4.0 gallons per square yard for six inch depth was used at an average cost of $0.13 per gallon on the job location. The total cost, including State Road Commission inspection and laboratory reports, approximated $0.825 per square yard.

Equipment Used

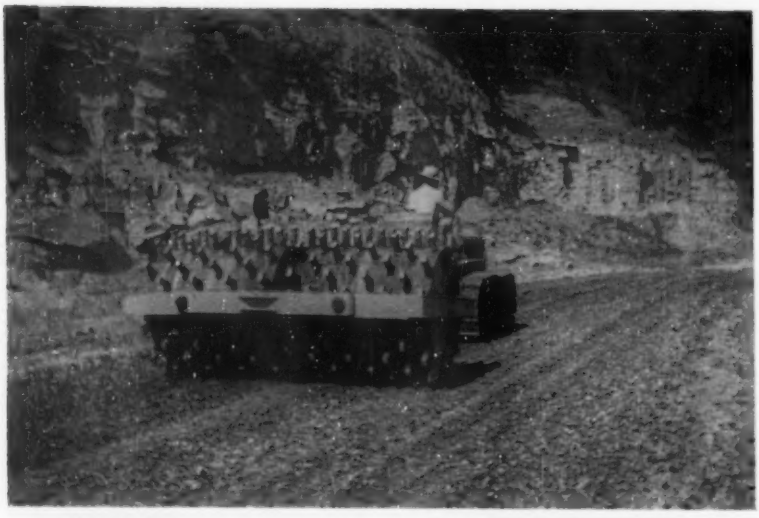
The contractor elected to use a P & H stabilizer to do the mixing, with good control of quantities. Due to the weight limitations of some of the bridges, it was necessary to use the smaller stabilizer which had a maximum width of five feet. It developed later this machine was adequate for our 18 and 20-ft. width roads. In addition to the P & H stabilizer, the following equipment was used:

2 patrol graders; 1 sheepsfoot roller (dual drum); 1 10-ton 3-wheel roller; 2 tractor trailers—4,000-gallon capacity; 1 pressure distributor; 1 water wagon with pump and necessary hose; 1 Bros heater; and 1 power broom.

Prior to mixing, the pavement was scarified to approximately 7½ inches loose and additional crusher run aggregate added to areas lacking required thickness. The additional aggregate was supplied and spread by State forces. Since the P & H stabilizer is a single pass mixer, considerably less mixing moisture was needed to obtain uniform dispersion throughout the mix. The water required was added to the SS-1 at an average rate of 5 parts SS-1 to 1 part water, or 2,500 gallons SS-1 to 500 gallons water. One pass mixed 1,450 feet, five feet wide, per load. Rate of mixing ranged from 27 feet on grades to 36 feet on level ground per minute. Daily production averaged 3,350 linear feet per day—20 feet wide. A minimum of 30,000 gallons SS-1 was used per day and since mixing temperature of only 100 to 110°F. was necessary in order for the meter to operate properly only one Bros heater was required to maintain this production. To assure proper depth and uniform moisture during operation, the mix was windrowed, exposing the subgrade on one half of the width. This was compacted and when necessary aerated to eliminate excessive moisture.

After alternating the windrow to the opposite side of the road and when the subgrade had dried sufficiently, the mix was spread and compacted with a sheepsfoot roller. The spreading must be done in such a manner and with enough moisture to prevent segregation of the mix. On several occasions it was necessary to leave the mix in a windrow for a day or two, requiring remixing by shifting the windrow several times to obtain uniform moisture again before compacting. When the sheepsfoot had walked out to within ½-inch of the surface, a light application of water was applied, followed by final grading to proper grade and cross section. Final compaction was obtained with a 10-ton 3-wheel roller. Some failures may develop in small areas due to excessive moisture, but these are easily corrected by additional aeration and recompaction. Back rolling with a flat wheel roller is desirable and should be continued until no netting or displacement occurs under all traffic conditions. Traffic is maintained during all construction. When the pavement has cured to 5 percent or less, it is swept with a power broom to remove any ground dust or foreign material, followed by an application of the 50-50 diluted SS-1 at the rate of 0.15 to 0.2 gallon per square yard. After thirty minutes to two hours the pavement is opened to traffic. This step completes the contractor's obligation, since a surface will not be placed until next year. We are presently contemplating a hundred pound treatment of either hot or cold mix.

● **AERATION is by a patrol grader; the mix is then spread and levelled.**



● **SHEEPSFOOT roller is used for compaction after spreading and leveling. When roller walks out to within ½ in. of surface, road is watered and shaped.**

We feel that by allowing the stabilized base to cure into the next year the trapped moisture will be further reduced and any failures which occur during the winter can be corrected before a surface is constructed.

Laboratory tests indicated 6.5 percent by weight of SS-1 be used. Marshall Test results on this mix average 2,400 pounds stability with a flow of 12.

Since 1953 we have stabilized 38 miles of secondary roads with emulsified asphalt, eliminating continuous blading to provide a smooth riding surface, as well as an undesirable dust hazard, thus providing a safe, all-weather, travel for school buses. Our truck traffic over these roads has increased carrying considerable tonnage of coal and farm and industrial products. Many tourists are using these improved highways as short cuts between through routes on our overcrowded primary system.

Due to the increased acceptance of this type of construction by the public and other engineers of our organization, it is predicted that considerable mileage will be undertaken in the next few years. This type of construction has become more than just a hit and miss operation. It is now a thoroughly engineered laboratory controlled operation, employing the use of the most modern up-to-date equipment and methods.

In conclusion, it should be remembered that in bituminous base stabilization our end product is a 5 to 6-inch compacted thickness of aggregate and asphalt base that is water resistant and stable; the most important advantage being the use of existing materials, with a final cost of $1.30 to $1.40 a square yard, as compared to $3.00 to $3.50 for other type construction.

We do not by any means have all of the answers to this type of construction and are continually searching for better and more practical methods and equipment to achieve lower costs and better end results.

This paper was presented at the ARBA meeting in Chicago. It has been slightly condensed from its original form.

Expansion joints a problem on

Pavement for the New Mackinac Bridge

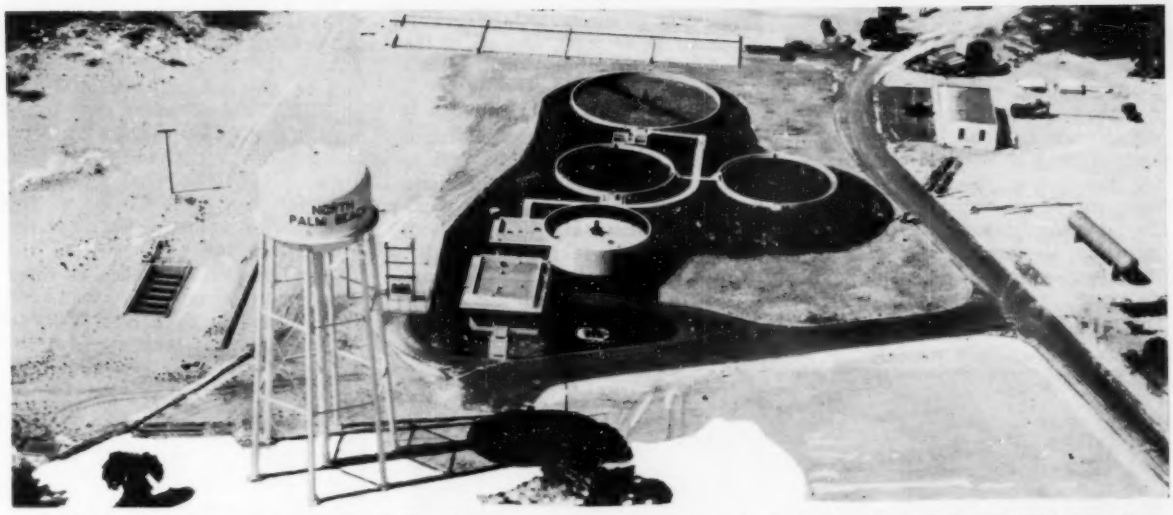
TRAVELERS crossing the Straits of Mackinac not only got a faster ride but they got a very smooth one, too. The new bridge which was opened to traffic November 1st, in time to handle the deer hunting season traffic, provides a year-round connection between the two parts of the State of Michigan and cuts time for crossing the straits to 10 or 12 minutes.

Paving the roadbed, the final step in the 3½-year construction project, presented the contractor with some unexpected difficulties. The almost 5-mile long bridge structure has approximately 80 expansion joints, each having steel lips which had to be flush with the finished bituminous surface mat. These expansion joints extended 1½-in. above the concrete bridge floor before a bituminous mat was laid down. A Cedarapids Bituminous Paver, manufactured by Iowa Manufacturing Company of Cedar Rapids, Iowa, proved able to lay a smooth, even surface up to and away from these joints. Oscillating

● **SMOOTH finished bituminous surface covers expansion joints without a ripple on the new Mackinac Bridge.**

track rollers on this new paver allowed the paver to pass over these joints without disturbing the screed. Previous to paving, the expansion joints were covered with masking tape to keep material from falling down into the joint, and after the paver had passed over the joint excess material was removed from the steel by hand.

The entire bridge and approaches provide two lanes of traffic in each direction with a 2-foot wide mountable center mall. On the suspension bridge section only the two outer lanes are paved; with steel grating roadway floor in the center two lanes. The outer lanes consist of 4½-inch grating filled with lightweight Portland cement concrete and topped with 1½-inches of bituminous. The center lanes are of open grating to reduce weight and for aerodynamic reasons.



● SEWAGE treatment plant utilizes biofiltration process to serve a new development planned for 25,000 population.

WATER and SEWERAGE for a New Residential Development

C. E. WRIGHT

AN ENTIRELY new residential community in Florida, located about three miles north of West Palm Beach, has been incorporated as the Village of North Palm Beach. This community is being pointed to as "the model for future development in Florida," particularly in its sewerage and water systems, in which the engineers were given a free hand to install the best that money could buy.

The Ross Brothers (Herbert and Richard), developers of this new community, planned for an eventual population of 25,000, started off with the purchase of 1,200 acres of raw land which spans U. S. Highway 1, the east coast route to Miami. The land investment was $3,700,000. In addition, $1,500,000 was spent on the sewer and water system, declared to be one of the finest of its size in the country. The land planning department of Brockway, Weber & Brockway, Inc., Engineers, of West Palm Beach, Florida, designed a residential community of 3,500 homesites, about half of them on waterways that connect with the Intracoastal Waterway, the Earman River and Lake Worth. Seward H. Mott & Associates of Washington, D. C., were employed to review the initial land planning features of the town. Adjoining the development on the north is an 18-hole golf course, now operated on a pay-as-you-play basis but eventually to be a membership club. An 80-acre shopping center and a marina are to be later developments.

The Engineering Department of Brockway, Weber & Brockway, Inc., of West Palm Beach, was retained to design a water and sewerage system for North Palm Beach and the nearby town of Lake Park. An existing 100,000-gallon elevated water storage tank in Lake Park was utilized; otherwise the entire systems including treatment plants were planned and constructed from scratch.

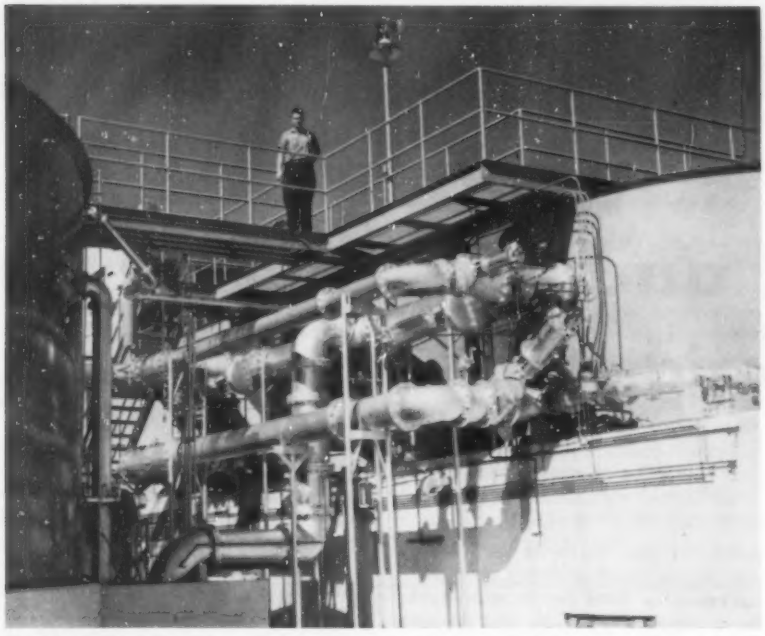
Pipeline Water Crossings

As the Village of North Palm Beach property spans the Intracoastal Waterway and Lake Worth, one of the current problems being encountered is to cross these waters to an ocean front area that has been laid out for an eventual population of 6,000. This will be achieved by constructing a 12-in. high pressure water main under Lake Worth and the Intracoastal Waterway for a distance of 4500 feet to the ocean front property. The pipe sections will be welded on shore, then floated across and sunk in a previously prepared trench. Midway in the lake, the pipe line will cross McArthur Island, going down again under a 300-ft. boat channel, then up on the ocean front property. It is estimated that the submerged water main will have a useful life of 50 years. Future construction plans call for the provision of a 500,000-gallon prestressed concrete ground storage reservoir and repump station to serve the ocean front property. To take care of both domestic and fire demands, repumping from the reservoir will be provided by horizontal split case centrifugal pumps, complete with automatic controls and auxiliary power facilities.

A well field to supply water to the two communities was constructed by the south bank of the Earman River, approximately 3 miles from the Atlantic Ocean. Twelve wells will eventually be constructed, but only four were included in the initial plan. Spaced 450 feet apart, each of these 12-in. diameter supply wells were drilled to a depth of 60 feet. Test pumping developed a maximum capacity of 500 gpm each, but the wells will be held to a discharge of 200 gpm

each to reduce drawdown. The vertical turbine well pumps and motors were supplied by Deming Pump Company.

Although the Earman River is a fresh water channel, draining the eastern part of Palm Beach County, the water becomes brackish near its mouth from tidal action. To overcome danger of salt water intrusion, the engineers located the well field approximately one mile up-stream from a salinity control structure, designed to maintain a backwater elevation well above any record high tide. Without such a control, there would be danger of salt water encroachment on the supply wells such as has already plagued many of the systems of Florida's coastal areas.



● PIPE gallery of the water treatment plant is exposed and as easy to get at as a pipe gallery can be. Like all parts of the system, treatment is automatic.

The Treatment Plant

The water treatment plant is electrically, pneumatically and hydraulically operated. Every step in the system—treatment and pumping process—is automatic except periodic charging of the chemical storage system. However, the plant can be operated either semi-automatically or manually by the operators in the event of an emergency.

The raw water has a color of 70, hardness in excess of 300 mg/l, 0.5 mg/l of iron, 30 mg/l of carbon dioxide, 0.5 mg/l hydrogen sulfide, and 25 mg/l of sodium chloride. After aeration and further treatment, the color is reduced to 5, hardness to 80 mg/l, and all of the iron, hydrogen sulfide and carbon dioxide is removed.

First step in water treatment is aeration for removal of hydrogen sulfide and carbon dioxide, and to help oxidize excess iron content. Aeration is followed by clarification and softening, stabilization, filtration and breakpoint chlorination. The clarification and softening processes are accomplished in a 40-ft. diameter by 14-ft. depth steel basin equipped with a high rate Accelator supplied by Infilco. Two circular filters, with four more proposed, are 18½-ft. in. diameter and are equipped with solenoid actuated, hydraulically operated gate valves. The effluent after filtration flows into a 120,000-gallon clear well located below the filters, where three 500 gpm at 160-ft. TDH Fairbanks-Morse, vertical turbine pumps discharge to the distribution system and to elevated tanks floating on the line. All water is metered in and out of the plant through venturi tubes. These tubes also serve to actuate transmitters to give time impulse signals to chemical feeders located within the main control building.

Electrically operated filter control tables work through differential pressure switches automatically to backwash and clean the filters at any predetermined loss of head without presence of the operators. After filter wash and rewash operations, the filters then return to service automatically. A 5000-gpm at 40-ft. TDH propeller type backwash pump was furnished by Fairbanks-Morse, equipped with an 8-in. pressure activated relief valve supplied by Ross Valve Company. The high service pumps which discharge water from the clear well to the distribution system and elevated tanks, operate from leased telephone lines connected to a new 300,000-gallon elevated tank located in North Palm Beach two miles east of the plant. A Builders-Providence telemetering system is used to send electric signals over leased telephone lines to the high service pumps controller.

Auxiliary power facilities at the water treatment plant are provided by a 150-kva Katolight butane driven electric generator located in the main control building. Butane is stored in underground tanks. The plant is also equipped with completely modern laboratory facilities supplied by E. H. Sargent and Company, and Metalab Equipment Company, to enable the plant chemist to make constant quality control analyses.

A three-story reinforced concrete building houses the control instruments, chemical storage and feeding facilities, laboratory and auxiliary power facilities. A 400-pound per day capacity automatic solution feed Wallace and Tiernan chlorinator supplies gaseous chlorine to the water as it enters the plant and as it leaves the filters. Lime for softening, polyphosphate for stabilization, and alum or ferric sulfate for coagulation, comprise the remaining chemical feed. Lime from a large storage room located above the plant clear well is conveyed by a Hapman-Dutton chain type conveyor to the feeder hoppers. By means of special levers, the lime is fed automatically into one hopper and then subsequent hoppers depending upon the chemical demand. Bindicator switches control the chemical flow from hopper to hopper. Chemical feeders were supplied by Infilco Inc., and chemical feed pumps were supplied by Worthington, Milton Roy, and Deming. Where required, the feed pumps were specially designed to resist corrosion.

Distribution System

Water supplied to consumers of Lake Park is sold on a master meter basis. Both the Lake Park and the Village of North Palm

Beach have separate water and sewerage utilities, North Palm Beach Utilities, Inc., serves the Village of North Palm Beach, and the Palm Beach County Utility Company serves Lake Park, both operating under franchise. Both companies sell to users on an individual meter basis, and the charges levied are average of the rates charged by a number of communities in the same area of Florida.

All of the water mains in North Palm Beach were laid before street paving was done, and water mains installed in Lake Park were laid in easements both in developed and undeveloped areas. The transmission main from the water treatment plant is 16-in. in diameter discharging into 10 and 12-in. diameter feeder mains and 8, 6 and 4-in. diameter sub mains. Fire hydrants were installed in accordance with the requirements of the National Board of Fire Underwriters, and all pipe is either cement lined cast iron pipe with mechanical joints or Johns-Manville asbestos cement pipe with Ring-Tite couplings.

The Sewerage System

A sewage treatment plant to serve both North Palm Beach and neighboring Lake Park was also designed by Brockway, Weber & Brockway. Although the Town of Lake Park did have an outmoded public water system, this was scrapped except for the 100,000-gallon elevated storage tank. There were no central sewerage facilities available. A complete sewage collection and pumping system was installed in both communities consisting of an interconnected network of vitrified clay gravity sewers, and bituminous lined cast iron force mains. Three underground sewage pumping stations were installed, with additional units to be provided as outlying areas tie into the collection system. Smith & Loveless of Kansas City, Mo., shipped completely assembled pumping stations to the job site. After excavation for the pumping stations, a reinforced concrete base slab was poured and the units lowered into position. After locating, the pumping stations were connected to the receiving wet well and discharge manhole, and placed in operation. Each of the pumping stations has auxiliary butane driven electric generators to be used in the event of electric power failure. Chlorination facilities were provided in the main pumping station situated about a mile from the treatment plant to provide positive odor control. From the main pumping station serving Lake Park, sewage is conveyed across the Earman River to gravity collection lines serving North Palm Beach. At this point, sewage from Lake Park meets with that from North Palm Beach, and the combined flow is delivered by gravity to the plant.

Sewage Treatment

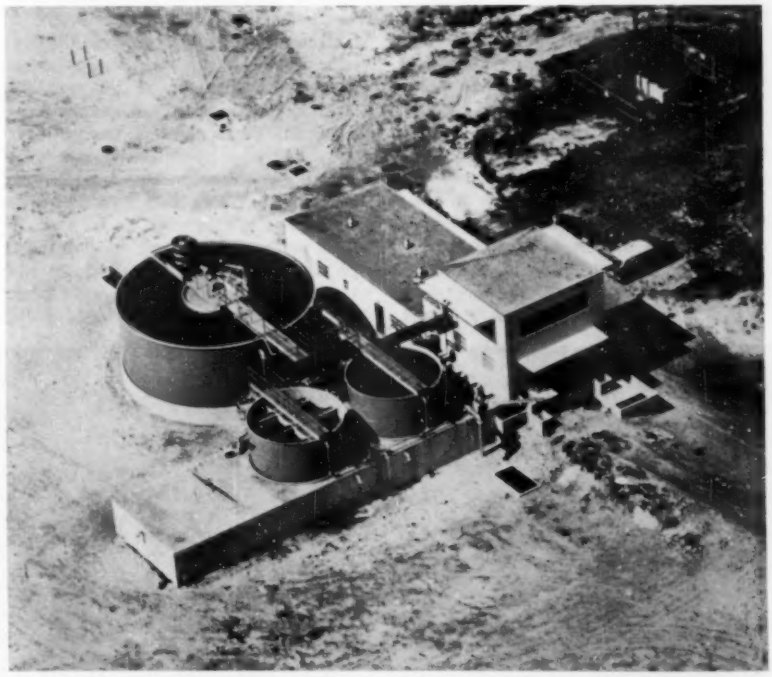
The treatment plant itself has been designed to present a most pleasing architectural appearance and it has been described as "elegant." The plant site equipped with its own underground irrigation system, is well grassed and landscaped.

As sewage enters the treatment plant, it first passes through a Worthington comminutor then flows into a wet well located below the main control building. From there, the sewage is lifted to a 55-ft. diameter primary clarifier and grease skimmer 8½-ft. deep furnished by the Dorr Company. The three sewage lift pumps are variable speed, non-clog, vertical centrifugal pumps furnished by Fairbanks-Morse. After a detention period of approximately 2 hours in the primary clarifier, the sewage flows by gravity to a Biofilter designed for a hydraulic load of 20 mgad and an organic load of 2,000 pounds of 5-day BOD / acre foot. From the biofilter, the sewage flows by gravity to a 55-ft. by 7½-ft. final clarifier, also furnished by Dorr. Sludge is returned from the final clarifier to the primary clarifier and from there it is pumped by a Marlow sludge pump to the digester. Overflow from the final clarifier is directed through a Parshall flume and chlorine contact chamber into the Earman River approximately one mile down stream from the salinity control structure. Biofiltration employed in this plant utilizes the return of final clarifier effluent to the filter influent through a pneumatically controlled sewage flow regulator.

The sludge digester is 50-ft. in diameter and 28½-ft. deep to provide a volume of 3 cu. ft. / capita at design load. The digester is equipped with a floating cover furnished by the Pacific Flush Tank Company who also provided the equipment for control and waste of excess digester gas.

Laboratory facilities provided at this plant were furnished by E. H. Sargent Company, and Metalab Equipment Company to provide precise operational control over the treatment process. Auxiliary power facilities were furnished by Katolight. A Simplex flow meter is remotely located in the main control building to totalize, indicate and record flow rates through the plant.

Operators at both plants have been specially trained and certified for this job by the Florida State Board of Health.



● **WATER treatment plant provides aeration, clarification and softening, stabilization, filtration and breakpoint chlorination. Water is from wells 60 ft. deep.**

PAVEMENT STRIPING

ROBERT A. BURCH,
Traffic Engineer,
North Carolina State Highway and Public Works Commission

PROPER driving on streets and highways is increasingly difficult because of the greater use of vehicles and the complexities of design built into highway facilities. We have a responsibility to give drivers the information they need to cope with today's complex driving problems. One of the greatest tools used in accomplishing this effect is pavement markings. For the relative cost of paint to the total cost of roadway these markings render the most service per dollar expended.

The end of World War II found signs and other markings on North Carolina roads badly neglected. We then started a program. At first we had a policy of painting any paved roads which carried in excess of 500 vehicles per day. As early as 1948 this was changed so that any road which justified paving warranted a painted centerline. By 1949 our painting policies included the use of reflectorized material on all lines painted.

With the adoption of this policy, new problems of application presented themselves. Several properties are absolutely necessary to constitute a good pavement marking paint. The material has to be of high viscosity in order to suspend glass spheres, and quick drying time is an almost "must". When

● **"ANY ROAD worth paving justifies use of a properly painted centerline."**

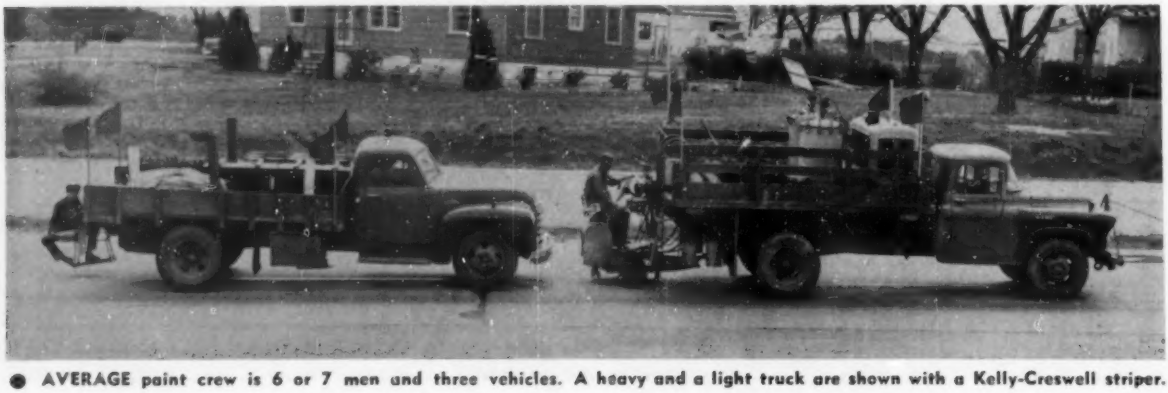
high viscosity is built into the paint it adds to the problem of application by choking lines and guns and sometimes causes the paint to set up in the containers.

Liquid vehicles can be added to the formulation to provide the desired drying time but frequently this develops an objectionable feature in that large proportions of vehicle (to obtain quick drying) cause the asphalt of the pavement to dissolve and bleed through the paint. Such bleeding obliterates the line. Another problem encountered is that of film thickness. It is always desirable to have a line last as long as possible. It is also reasonable to think that a line will last in accordance with the amount of paint applied. This has not proved to be true with centerline paints. After much trial and error it was decided that the optimum film thickness should be 15 mils which requires an application of approximately 16 gallons per mile for a line 4 inches in width. Thicker applications than this frequently kept the paint from drying properly. For example, if the paint skin-dried to such a degree that the top was no longer tacky before the bottom dried then it would trap the mixing vehicle in the middle and cause it to lay against the asphalt and soften it.

Many commercially manufactured paints were tested and performance studies were conducted for four consecutive years by placing longitudinal stripes across the highway to obtain accelerated wear and to determine the total useful life of the material. Then a formula was used to compute the cost per day of useful line. In these tests it was proven that the more expensive paints were the cheapest per day to use.

Materials Required

The 200,000 gallons of paint we use each year is manufactured by the Highway Department in its Prison Industries. All of this paint is reflectorized by suspending beads in the paint. Due to manufacturing problems, reflecting qualities were not realized to a satisfactory degree from the material used in 1954 and 1955. In 1956 and again in 1957 we have supplemented the premixed material by dropping on top of the painted line an extra portion of glass beads in order to add to the reflecting qualities of our material. Three to four pounds of beads per gallon have been dropped on in ad-



● **AVERAGE paint crew is 6 or 7 men and three vehicles. A heavy and a light truck are shown with a Kelly-Creswell striper.**

dition to the 4½ pounds of beads premixed into the material.

In the early stages of our accelerated painting program we found that the life of a painted line not only depended upon the quality of material used but also upon its method of application. One of the controlling factors in the life of a line is the pressure at which it is applied. We early concluded that good application required approximately 100 pounds of pressure on the gun lines with a slightly lesser amount on the paint tank and lines. Therefore, our first objective was to build or buy equipment which would provide this required pressure properly to break up and atomize the high viscosity materials.

Equipment Used

A majority of the striping machines used by North Carolina in the 1940's were made in our own shops. We made our first truck mounted machines. This machine has a 30 and 60-gallon tank with an 80-cu. ft. air compressor. The machine has been in use for ten years with only minor repairs and replacements.

Another type of machine is built on a cab-over-engine truck with a 105-cu. ft. Schramm compressor with two 60-gallon tanks. This machine is one of the first ones built with electronic controls and does not require an operator to ride on the paint dolly. Three such machines were bought at the same time and have been in use for five years. They were designed to operate at very high speeds and can maintain a continued speed of 15 mph with satisfactory application.

A striper purchased from the Meili-Blumberg Company is one of three similar machines in use by us and has two 60-gallon tanks with a 125 cu. ft. air compressor. It does a satisfactory job at relatively high speeds.

A striper purchased from the Kelly-Creswell Corp., has equipment similar to the Meili-Blumberg unit. The principal differences are in the paint dolly, paint guns, and lines with cleaners and strainers. This also has a 125-cu. ft. air compressor.

The Meili-Blumberg Super 10 machine is one of three used in the western part of the State where steep grades and narrow pavements are prevalent. This machine is preferred for mountain use because it does not consume as much road width as the truck mounted units. The machine is self-propelled and has no connection with the truck and trailer. This machine has a 60-gallon tank and a 30-gallon tank with the larger one being used for the yellow paint since more gallons of yellow are required in mountain areas than white.

The N. C. State Highway Commission is divided into 14 operating divisions. This, to some degree, accounts for the wide assortment of equipment being used. Personal preferences, as well as wide differences in terrain, justify our lack of standardization on any particular striper. In general, all divisions agree that a truck-mounted machine is most desirable and the most important single requirement of the machine is that it have a compressor with a capacity of 125-cu. ft. in order to operate three paint guns and two tank agitator motors simultaneously. Second in importance probably would be good, high capacity guns capable of spraying beads.

Pattern of Line

Before the 1948 edition of "Manual on Uniform Traffic Control Devices for Streets and Highways" was released, North Carolina adopted the two-color pavement marking system with a pattern of line as described in this manual. A skip line is painted for the centerline—a 15-foot painted section in each 40-foot cycle. A continuous or solid yellow color line is painted for barrier lines. North Carolina was one of the first states to standardize on this pattern of line and we have found that the yellow barrier line is a great aid to drivers and promotes safety. We feel that there is no regulation on the highway which demands more respect and is observed better than this yellow barrier line indicating that passing is not permissible.

Operational Data

The average paint crew consists of 6 or 7 men and 3 vehicles. A heavy duty truck and one pick-up usually supplement the paint machine. The heavy duty or supply truck travels 1000 feet in advance of and in the same position that the paint machine travels. Following the paint machine is the pick-up truck which places and retrieves rubber cone traffic line protectors used while the line is drying. Four-

● **SEVERAL Meili-Blumberg stripers are in use. The self-propelled Super 10 is preferred for use in the mountain districts.**

teen such outfits are now in use. The 14 divisions have in addition to the high capacity machine a small self-propelled one-line unit which is used for special jobs, such as painting worded messages and arrows on pavement and painting channelizing islands, delineators and other forms of curbs. The small units as well as the larger ones are equipped with hand guns.

Prelining presents a troublesome job and frequently delays production. The simplest and fastest painting is that of tracing an old line. But due to the fact that thousands of miles of pavement are resurfaced each year it is necessary to re-establish centerlines by prelining. Many devices have been tried by our field forces for use in prelining. One machine, devised by one of our Sign Supervisors, is a triangular vehicle powered by a Briggs and Stratton engine. The guide or pointer follows the edge of pavement and at the same time drops a small quantity of lime water or thin paint which will quickly wear off at the opposite side of the machine at a point one-half the width of pavement. A more commonly used type of device for prelining is a pick-up truck with a steering device mounted on the right running board or in the right door so as to position the operator over the right edge of the pavement. On the left side of the pick-up, a bicycle wheel or other marking device is used to mark a uniform line at a consistent and predetermined distance from the right edge of pavement. Due to variations in width of pavements it is frequently necessary to run the preliner in both directions. This will give two lines in the center of the road with a space between them. When two lines appear it is necessary for the operator of the paint striper to position his pointer so as to bisect the space between these two prelines in order to paint on the exact center of road.

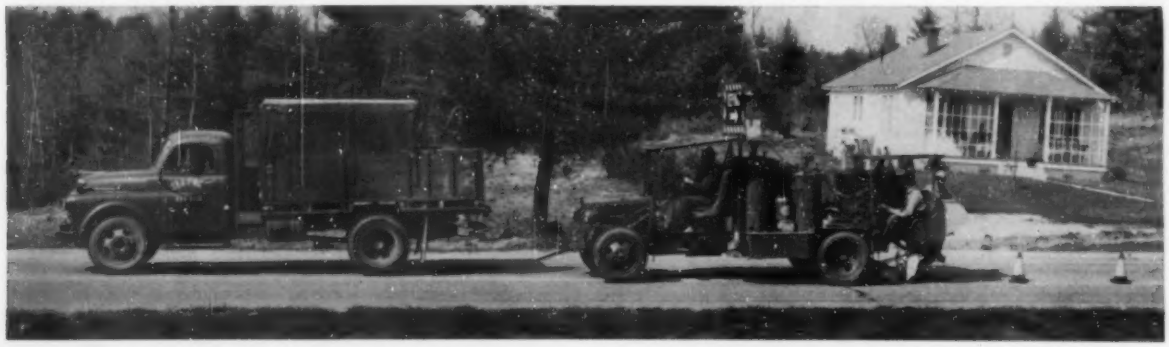
Yellow barrier lines are painted at all places where the sight distance is less than 600 feet. The establishment of points where this barrier line should begin and end is another job necessary before the paint machine travels over the road. These points are established by tying a piece of rope 600 feet long to the rear of a car and allowing the other end to drag loose along the road. As the car pulling the rope moves along the road a second car or pick-up trails behind so as to be always at the end of the rope. When the lead car begins to lose sight of the trailing car by going over a hill or around a curve both cars stop. The beginning point of the restricted sight distance is marked opposite the trailing car. After marking the beginning both cars move ahead with the rear car staying at end of rope and when the rear car comes in view of the lead car both cars again stop. The end of the restricted light is then marked opposite the rear car.

Painting is confined to the summer months and then only when weather is warm and pavement is dry. Painting is not permitted when pavement is cold or damp because applications at such time will not give satisfactory life. With procedures used as outlined herein it appears that a few summer months would be ample time to do all needed painting, However, this is not the case. We have discussed painting lines at the rate of 15 miles per hour which might indicate that in a normal day's work more than 100 miles could be painted. As a matter of fact, 40 miles per day for one machine is an exception rather than the rule and the average day's production per unit is more likely to be between 20 and 25 miles. There are many things to slow up and stop the paint machine. For example, painting may not be able to start early in the morning because of dew or of the necessity for a long drive to the place where work begins. Delays caused by stopping the machine to fill up the paint tanks and many other unexpected conditions are unavoidable. In order to speed up and expedite the refilling of tanks on the road the paint to be used today was rejuvenated yesterday in the paint shops by use of mechanical agitators. All paint is agitated without opening the container and then stored upside down overnight for the next day's use.

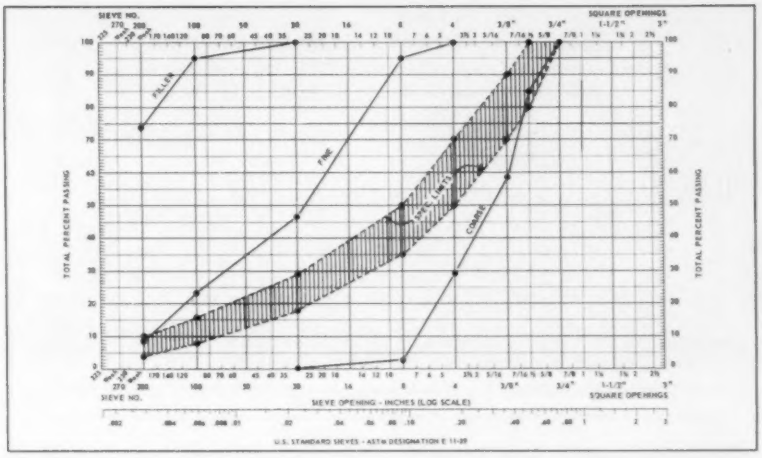
Records for each of the past five years show that North Carolina has painted in excess of 16,000 miles of new line per year. This means that at any given time we have in excess of 20,000 miles of good, usable line. However, with 33,750 miles of pavement out of a total rural system of 67,612 miles it is seen that we have not yet reached our goal of having a good line on all of our pavement.

Shoulder Lines

Possibly the latest innovation in North Carolina's striping program is the placement of shoulder lines. Beginning last year we placed several thousand miles of painted line on each edge of the pavement next to the shoulders. The design pattern of this line is different from that used on the centerline. We maintain the same 40-foot cycle as on the center but paint only 5-foot sections of line in the cycle. This accomplishes two purposes: It requires only one-third of the amount of paint and it makes a distinction between this and the centerline with the hope that it will not be interpreted as a lane line. It is now our policy to place these white lines on all two-lane US routes and on other two-lane routes with heavy traffic volumes. This practice may have been started with frowns and criticisms, but these shoulder lines have met with great public acceptance and have proven their worth from a public relations standpoint if no other.



● IN THE early days of marking, most of the striping machines were made in the Department shops, such as the unit shown here.



● **AGGREGATE grading chart, showing coarse, fine and filler curves, and limits permitted by the specifications.**

Design of ASPHALT PAVING MIXTURES

LADIS H. CSANYI,

Professor in Charge,
Bituminous Research Laboratory,
Iowa State College

ASPHALT PAVING mixtures must be designed to carry and withstand the effects of the traffic that they will be called upon to convey during their long and useful service life. The design must be effective, efficient and economical. Since the character and intensity of traffic will vary considerably on different roads and streets, one of the many types of bituminous mixes available must be carefully selected and designed to meet the traffic needs encountered. Consideration must be made not only for the structural aspects but also to the economical aspects in the selection and design particularly when large increases in traffic are anticipated. Location of sources and character of aggregates, construction equipment available and speed with which the job must be completed may also have material influence upon the type and design of the mixture.

There are many types of bituminous paving mixtures from which to choose, each of which is best suited to a particular character of traffic and conditions prevalent.

Traffic, weather and climate impose various types of physical stresses upon a bituminous pavement. These stresses may combine or offset each other depending upon conditions. A pavement design which can successfully carry a certain character of traffic in a cold dry climate may fail under similar traffic in a hot wet climate. Thus if a mix design is to serve effectively it must include consideration for the type, character and action of the stresses imposed.

Traffic imposes two basic types of stresses; one the effect of the weight and concentration of the loading of the vehicle or a compressive or shearing stress; the other due to the movement of the vehicle, its acceleration or braking creates a dragging or shoving or tensile stress Weather or climate causes a combination of stresses. Hot weather that softens the binder will intensify the effect of traffic stresses. Moisture entering a porous pavement will create internal rupturing stresses in freezing weather.

Resistance to displacement under load may be designed into a paving mixture in several ways. First, by the type and character of aggregate used. Hard, tough, angular and clean aggregates which develop a high degree of interlock can resist heavy loads. Second, well graded aggregates by providing good interlock and having a large area of contact permit the binder more effective cementing action, and also by providing a greater density can also resist heavy loadings. Third, by the use of the proper type and quantity of binder. The quantity of binder used is extremely important, because insufficient binder will not properly cement aggregate particles together while excess binder will destroy interlock.

DESIGN CRITERIA FOR VARIOUS TESTS

	Sheet Asphalt	Asphaltic Concrete	
Test		*Medium Traffic*	*Heavy Traffic*
Hubbard-Field			
2" mold	1200-4000 2000 min. for heavy traffic	—	—
6" mold	—	1200-4500	2000-6000 3500 min. for concentrated heavy traffic
Marshall			
Stability 140°Wet	300	500-1200	1000-2000
Flow 140°Wet	20 max	12-20	8-20
Hveem Stabilometer	15-30	35-50	35-50
Hveem Cohesiometer	75-175	50 min.	50 min.
Triaxial		6-100	6-100
Cohesion	8-20		
Angle of Friction	25-40	25-52	25-52

Table 1(a)—Hot Mix Asphaltic Concrete

In these mixes asphalt cement of 85-100 or 120 to 150 penetration are used.

Combined Aggregate Total % Passing by Weight

Sieve Size	Intermediate or Surface	Surface	
1½"	100	.....	.....
1"	95-100	100	.....
¾"	.....	95-100	100
½"	70-85	75-90	95-100
No. 4	40-55	45-60	60-80
No. 10	30-42	35-47	40-55
No. 40	20-30	23-33	25-35
No. 80	12-22	16-24	18-27
No. 200	5-10	6-12	8-15
% Asphalt Cement per 100 pounds of Aggregate	5-7	6-8	6-8.5

Table 1(b)—Hot Mix Stone Filled Sheet Asphalt Surface

Sieve Size		
Passing	*Retained On*	*Percent*
½"	No. 10	20-35
No. 10	No. 40	7-30
No. 40	No. 80	11-40
No. 80	No. 200	10-30
No. 200		7-12
Bitumen		7-9.5

Table 1(c)—Hot Mix Sheet Asphalt Surface

Sieve Size		
Passing	*Retained On*	*Percent*
No. 10	No. 40	10-40
No. 40	No. 80	20-45
No. 80	No. 200	12-32
No. 200		10-20
Bitumen		9.5-12

Table 1(d)—Hot Mix Sand Asphalt

	Percent	
	Base	*Surface*
Passing No. 4 Sieve	100	100
Passing No. 200 Sieve	0-25	10-30
Bitumen	4-7	5-10

The cohesive property of a mix or resistance to traffic wear and tensile forces may also be controlled in design in several ways. One is by the type of binder used. A harder asphalt 85-100 penetration as compared to 150 to 200 penetration will usually generate greater tensile strength. Binders which set more quickly will develop the tensile strength more rapidly than slower setting ones, as asphalt cements in comparison with cut backs that set slowly. Strong adhesion between binder and aggregate is also obviously essential. A well graded aggregate will also enhance cohesion because aggregate particles are in more intimate contact thereby giving the binder a greater area of effectiveness.

Resistance to weather and climate may also be designed into a mix in several ways. Here again the type of binder used is of importance. A harder binder, with a low temperature susceptibility is desirable in hot climates, while a softer asphalt serves better in cold climates. Well graded aggregates giving a dense mix that prevents infiltration of moisture serves well in preventing the effects of freezing and thawing and wetting and drying.

From the foregoing discussion it can be noted that a well graded, comparatively dense mix with the proper quantity of binder can usually meet all of the forces imposed by traffic and weather or climate. Under heavy traffic where the forces are intense great care must be exercised in design. As traffic decreases, care must still be exercised in design but the refinements of aggregate type and combination and type and character of binder may be relaxed to meet economic pressures.

General Formulas for Mixes

The formulas for mixes in Tables 1, 2 and 3 are general formulas with a relatively wide range of aggregate gradation which must be adjusted for local traffic conditions. They serve primarily as guides for specific designs.

Test of Paving Mixes

Every design of a bituminous mixture should be tested to either verify or adjust the design to assure that the mix possess the desired characteristics needed for the purpose to which it is to be applied.

There are a number of paving tests that have been accepted and are being used for this purpose. These tests include the Hubbard-Field Stability, Marshall Stability, Hveem Stability and Cohesiometer and the Triaxial Test. Details of the test are not given here because they are available in several publications such as the "Mix Design Methods for Hot Mix Asphalt Paving" published by the Asphalt Institute.

Mix designs which do not meet the criteria shown above must be adjusted with regard to quantity of binder or gradation of aggregate to meet criteria.

In the preceding tests the Hveem and Triaxial determine cohesion directly. In the Marshall the flow is an indirect measure of cohesion.

For additional detailed information concerning design of bituminous mixes attention is directed to the publications of the Asphalt Institute, and the Highway Research Board, from which some of the foregoing data have been secured and also to the Proceedings of the Association of Asphalt Paving Technologists.

Table 2—Plant Mix Cold Laid—Dense Graded

Total Passing	Percent by Weight
1" Sieve	100
½" Sieve	75-90
No. 4	50-70
No. 10	35-50
No. 40	20-30
No. 200	4-8
Binder used MC-3 residual bitumen	4.6

Table 3(a)—Road Mix Asphaltic Concrete*

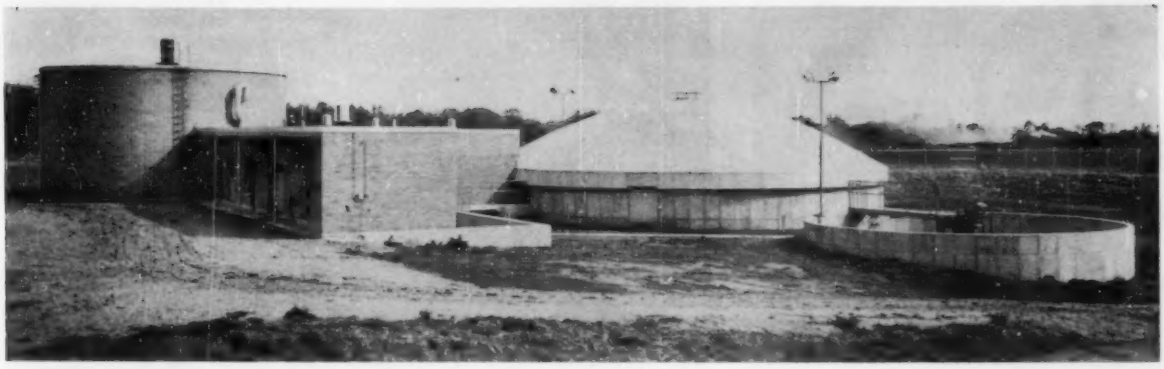
Total Passing	*Percent by Weight*
1" Sieve	100
No. 4 Sieve	50-70
No. 10 Sieve	35-60
No. 200 Sieve	0-14
Bitumen	4-7

Table 3(b)—Dense Graded Road Mix*

Total Passing	*Percent by Weight*
¾" Sieve	100
½" Sieve	80-100
No. 4	35-75
No. 10	20-60
No. 40	10-35
No. 200	0-8
Bitumen	4-7

*Type of bitumen depends on method of construction.

Travel Plant	AC or RC or SS emulsion
Blading	MC, SC or SS emulsion



● TRICKLING FILTER has thin-shell reinforced dome as cold weather protection; also shown are digester, clarifier and office.

SEWAGE TREATMENT PLANT *is Designed for* EASY OPERATION

GLEN G. EHRICH,
Project Engineer,
Stanley Engineering Company,
Muscatine, Iowa

"NEAT AND ATTRACTIVE" is the description for the recently completed sewage treatment plant at Luverne, Minnesota. The newest of the City's public utilities, it displays a modern trend in treatment plant decoration. Pleasing effects have been created by the use of color in the control building. Brightly painted walls and equipment produce a light, cheerful interior not ordinarily associated with a waste treatment plant.

Planned and designed with the operator in mind, this sewage treatment plant offers an arrangement and atmosphere conducive to good operation.

Some of the most important considerations, and those which are often overlooked when designing a sewage treatment plant, are the details which make the operator's duties safer and more pleasant to perform. Even the small projects are deserving of attention to detail in order to produce a plant which an operator "wants" to operate and maintain properly and in which he can take pride.

A number of features were incorporated in the Luverne plant to help make it more than a run-of-the-mill sewage treatment plant. Of first importance is the compact arrangement of the plant which permits the great majority of the operating functions to be carried on under cover of the control building. This is especially advantageous to the operator during the cold winter months.

Designed for maximum utility, the control building is divided into several distinct areas. The basement has two separate rooms, one of which contains the grit channel, Parshall flume, comminutor and wet well. Although easily accessible, the isolation of this section of the building provides some degree of safety from the standpoint of odors, explosive gases and flooding. The other portion of the basement is the pump room which contains the raw sewage pumps, raw sludge pumps and sludge circulation pumps. Also located in the pump room are all of the plant control valves except those used for draining the settling tanks.

Located on the ground level of the control building is a gas control room; an outside storage room; a digester heater and heat exchanger room; a combination office and laboratory; a toilet and shower room; a combination garage and workshop; an inside storage room; a chlorinator room; and a grit elevator room.

The basement walls and ceilings and the equipment are painted with an array of bright colors. All piping is color coded to distinguish the various piping services. Starting out with clean, bright surfaces tends to inspire good housekeeping by presenting a challenge to the operator to keep things looking neat and in first-class condition.

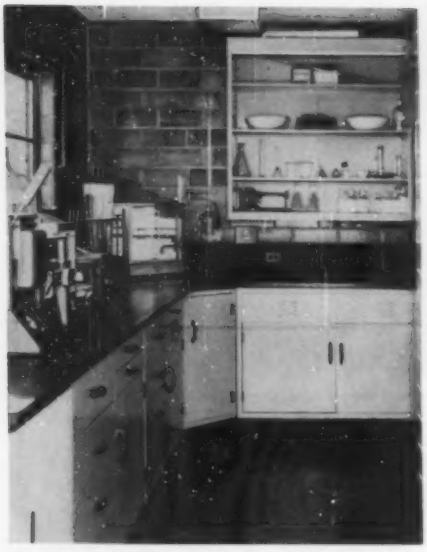
In the interest of safety, positive mechanical ventilation was provided in the gas control room, the chlorinator room and both sections of the basement. The ventilators are activated by door switches and have a manual shut-off with a red indicating light.

Design Bases

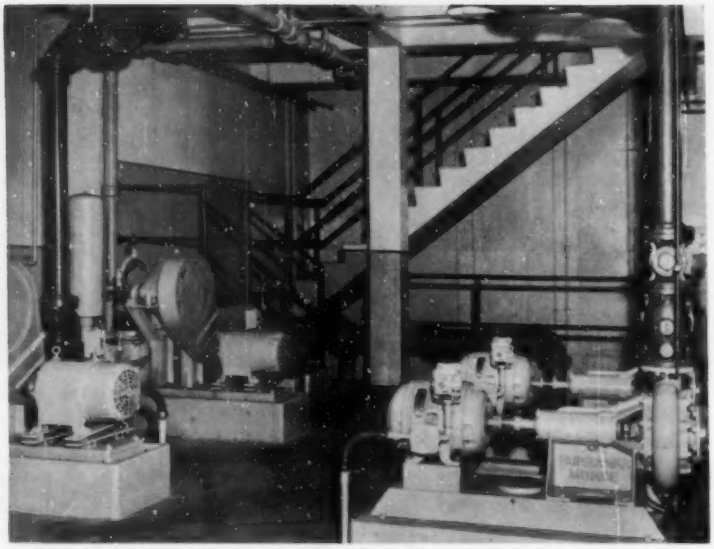
Designed for a population equivalent of 6,400 and an average dry-weather flow of 500,000 gallons per day, the treatment plant includes grit removal, comminution, primary settling, high-rate filter biological reduction, final settling and post-chlorination. Sludge is digested and then de-watered on sand beds. Flow arrangements are such that either individual units or the entire plant may be by-passed.

The high-rate filter provides adequate treatment for the Luverne sewage during periods of normal river flow and is reinforced by post-chlorination during periods of low river flow; it was also the most economical of the methods studied.

As an added feature, the 60-ft. diameter high-rate trickling filter is equipped with a thin-shell reinforced concrete dome to prevent freezups during cold winter months. Another interesting feature of the plant is the raw sludge draw-off arrangement for the primary



● **LABORATORY at the Luverne plant provides facilities for all needed control tests.**



● **PUMP ROOM is separated from comminutor, meter and wet well which are also in the basement of the operating building. All piping is color coded.**

settling tank, which allows the sludge to be pumped with either manual controls or time-clock from the primary tank or to be drawn into a sludge well adjacent to the primary tank before pumping to the digester. The sludge well is equipped with a telescoping valve which is operated by means of a rack-and-spur gear arrangement to allow quick changes in the overflow elevation. The advantage of being able quickly to change the overflow elevation permits the operator to draw off sludge at a more uniform rate and thereby prevent sudden surges which may carry an excessive amount of water over with the sludge.

Outside lighting and hose connections for washing purposes are provided at all treatment units. The plant area is protected from flooding by a levee and is enclosed by a suitable fence.

Another important detail was the provision for plant expansion. Additional units can be added to the existing plant with a minimum of disturbance to the existing structures and piping.

Most of the plant features described in this article are nothing more than details when compared to the complete design. Nevertheless, they are the things that help make a sewage treatment plant something more than a cluster of concrete tanks with connecting piping.

Whether or not the treatment plant does a better job of treating the sewage because of the various details mentioned will probably never be known. In any event, the operator's duties are far more pleasant; and the City can point with pride to an outstanding public utility.

The treatment plant was designed by Stanley Engineering Company of Muscatine, Iowa, and constructed by the Spencer Construction Company of Spencer, Iowa. The electrical construction was done by the McClure Electric & Plumbing Company of Luverne, Minnesota. The entire cost of the project, including engineering, legal, right-of-way and administrative costs, was approximately $270,000.

The plant is in charge of Paul Pierson, full-time superintendent, who performs all routine operating and housecleaning tasks, as well as necessary laboratory work. Occasional assistance for heavier chores is provided from other city departments.

Equipment Used

The grit equipment and the rotary distributor were supplied by Walker Process Equipment Co. Simplex Valve & Meter Co. furnished the flow meter and Chicago Pump Co. the comminutor. Dorr-Oliver equipment was used for the clarifiers and a Pacific Flush Tank digester, heater, heat exchanger and gas control equipment. The chlorinator is a Builders-Providence; the sewage pumps, recirculation pumps and sludge heater pumps are Fairbanks-Morse; the raw sludge pumps are Marlow; and the motor control center was furnished by Square D Co.

Refuse Collection Methods in Waterbury

WALTER M. KUNSCH,
Supt., Waste Treatment Plant
Waterbury, Connecticut

In Waterbury, Conn., at present we pick up only garbage and combustible matter that can be fed to the incinerator. This collection is made twice weekly, with crews covering the City once every three days, working a total of six days per week.

In mid-September we began "total collection" of materials, with pickup of non-combustible matter once every two weeks. The collection of combustibles is continued on a twice-per-week basis. We also begin a 5-day week at that time and have additional trucks on order to permit making these changes.

Much of the terrain in Waterbury is hilly. Many pickups require climbing up and down steep steps or slopes. This affects the number of pickups made per day, compared to communities with more level terrain.

At present we use 14 packer trucks and we have six others on order. A rough average of the weight of refuse in a fully loaded 15-cu. yd. packer is 7,500 lbs. We believe that when 20-cu. yd. packers have been in use for some time we will find them more economical than the 15-yd. units.

DESIGNING

BASES FOR ROADS AND STREETS

F. N. HVEEM,

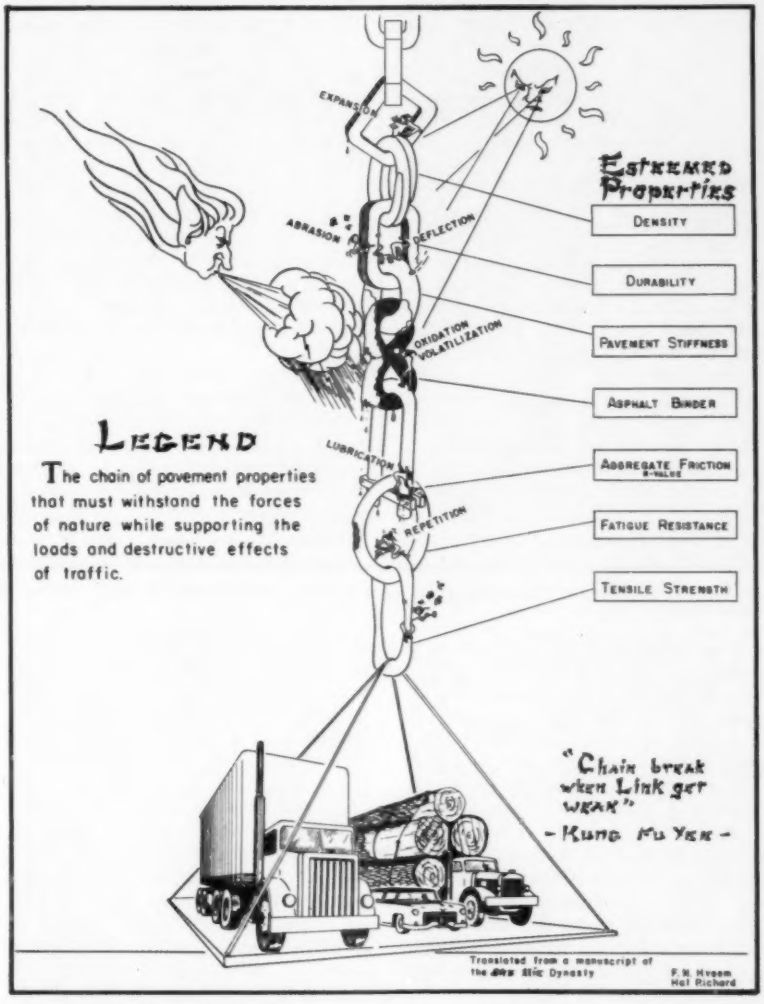
Materials & Research Engineer,

California Division of Highways.

IT IS RATHER common practice to assume that the designer of a new highway should work out both geometric and structural details. Actually, there is virtually nothing in common between the principles, considerations and controls that affect such things as roadway width, sight distance, curvature, intersections and interchanges and the factors that should be weighed in establishing the type, thickness, slab strength and other properties that enable the pavement to withstand vehicle loads and the deteriorating influences of time and weather. In the pavement field geometric warrants and structural controls are two different problems.

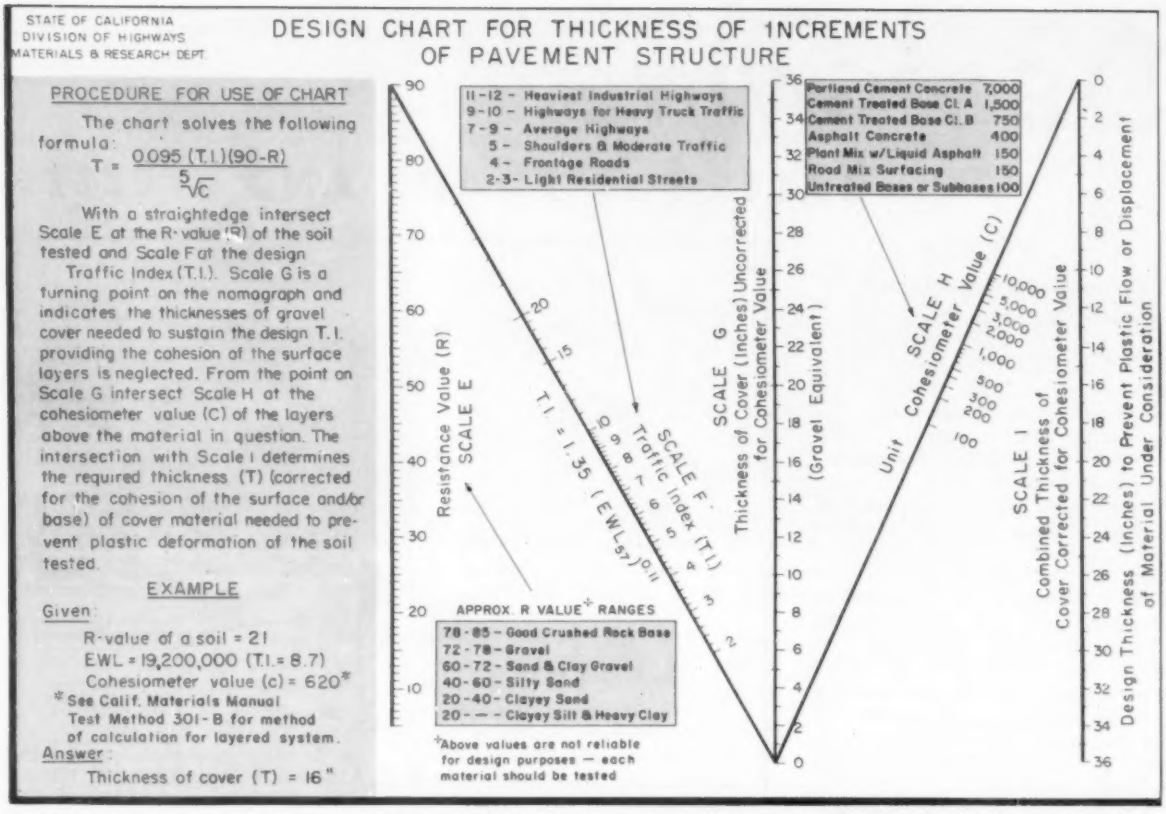
The designing of bases, while only a part of the pavement structure, is often the most important part. Most engineers responsible for selecting highway pavement types and for estimating the thickness of base and surface will speak of their pavements as having been "designed"; but in many instances structural designs are made either to fit the money or simply to correspond to some more or less arbitrary standard. For example, some highway departments have a "standard" concrete pavement and the same thickness of pavement is used for any and all conditions of traffic and soil whenever a concrete pavement is constructed. In other cases, the thickness of pavement or base is governed largely by the amount of money available. There are, of course, good arguments for having standard minimum sections with which contractors can become thoroughly familiar. It is probable that the type and thickness of the base layers under most pavements have been selected according to "judgment" or "precedent." Such pavements may give a good performance, but this process of selecting a type and establishing the thickness of the various layers can hardly be dignified by the term "design."

Some of the foregoing statements may sound harsh and over-critical of fellow engineers but there is some justification and a good many excuses for those who are forced to rely upon personal experience rather than formulas. In the first place, no mathematical formula based solely on fundamental concepts has yet been developed (or has been accorded widespread recognition) which will reliably predict the performance of all types of pavement. A list of over twenty formulas could be compiled quite easily[1]; and some are being used. However, it is probable that the relationships between the various pavement properties and the destructive agencies can only be approximated by a formula.



● **PICTOGRAPH emphasizes the many properties that affect pavement performance.**

The broad problem of pavement design is easily stated. The engineer has to evaluate the future traffic loads and their cumulative effect over a period of 10 or 20 years; then evaluate the ability of the soil to sustain loads; and insert one or more layers of material (of known strength and durability) between the soil and the traffic to bridge the gap between the two original evaluations. Consideration of each of these three steps immediately opens up


STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
MATERIALS & RESEARCH DEPT.
DESIGN CHART FOR THICKNESS OF INCREMENTS OF PAVEMENT STRUCTURE
PROCEDURE FOR USE OF CHART
The chart solves the following formula:
T = 0.095 (T.I.)(90-R) / ∛C
With a straightedge intersect Scale E at the R-value (R) of the soil tested and Scale F at the design Traffic Index (T.I.). Scale G is a turning point on the nomograph and indicates the thicknesses of gravel cover needed to sustain the design T.I. providing the cohesion of the surface layers is neglected. From the point on Scale G intersect Scale H at the cohesiometer value (C) of the layers above the material in question. The intersection with Scale I determines the required thickness (T) (corrected for the cohesion of the surface and/or base) of cover material needed to prevent plastic deformation of the soil tested.
EXAMPLE
Given:
R-value of a soil = 21
EWL = 19,200,000 (T.I. = 8.7)
Cohesiometer value (c) = 620*
*See Calif. Materials Manual Test Method 301-B for method of calculation for layered system.
Answer:
Thickness of cover (T) = 16"
11-12 - Heaviest Industrial Highways
9-10 - Highways for Heavy Truck Traffic
7-9 - Average Highways
5 - Shoulders & Moderate Traffic
4 - Frontage Roads
2-3 - Light Residential Streets
Portland Cement Concrete 7,000
Cement Treated Base Cl. A 1,500
Cement Treated Base Cl. B 750
Asphalt Concrete 400
Plant Mix w/Liquid Asphalt 150
Road Mix Surfacing 150
Untreated Bases or Subbases 100
Resistance Value (R)
SCALE E
T.I. = 1.35 (EWL×57)^0.11
SCALE F
Traffic Index (T.I.)
SCALE G
Thickness of Cover (Inches) Uncorrected for Cohesiometer Value
(Gravel Equivalent)
SCALE H
Unit Cohesiometer Value (C)
SCALE I
Combined Thickness of Cover Corrected for Cohesiometer Value
Design Thickness (Inches) to Prevent Plastic Flow or Displacement of Material Under Consideration
APPROX. R VALUE* RANGES
78-85 - Good Crushed Rock Base
72-78 - Gravel
60-72 - Sand & Clay Gravel
40-60 - Silty Sand
20-40 - Clayey Sand
20-— - Clayey Silt & Heavy Clay
*Above values are not reliable for design purposes — each material should be tested

● **FIG. 1. Design chart developed to show required thicknesses of pavement for various traffic loadings and types of surfaces.**

several questions. First, if an engineer is to build any sort of structure he ought to have some idea of what sort of load the structure is to sustain or what forces the structure should resist. A simple static load can act in a variety of ways, depending upon its location and concentration, but the problem of moving loads and the number of repetitions of wheel load make this part of the problem very complex, to say nothing of the fact that vehicles vary widely in volume, weight, load distribution, number of axles, axle spacing, speed, etc.

Structural Design

If an engineer is going to work out the structural design of a pavement, he must reduce all the traffic variables to some sort of usable number. If we break down the traffic pattern, we would find that traffic subjects the pavement to at least four principal variables and three secondary variables as follows: The principal variables are wheel load, repetitions, area of load influence and speed; the secondary variables are the contact area (pressure), number of tires and axle spacing.

In the formula now being used by the California Division of Highways, the miscellaneous heavy traffic that is expected to use a road is converted to a number called the "Traffic Index." The first step is to calculate an Equivalent Wheel Load from the number of trucks of the different sizes and axle combinations. The estimated number of trucks are arranged into five groups representing those having two, three, four, five, and six axles, respectively. Such an estimate can be made by counting the existing traffic and adding a suitable value to allow for future increase. When the hypothetical number of trucks in each axle group has been established or estimated the calculation for the equivalent wheel load is made by multiplying the number of vehicles in each axle group by a constant. The following constants are now being applied to miscellaneous traffic on California highways where the traffic includes trucks of different sizes with loads ranging from empty to full legal load which is 18,000 lbs. on single axles and 32,000 lbs. on tandem axles. The axle groups and constants are as follows: 2-axle x 330; 3-axle x 1070; 4-axle x 2460; 5-axle x 4620; and 6-axle x 3040. The equivalent wheel load (EWL) is the sum of the products of these groupings and this gives a basis for evaluating the traffic to be carried. These constants should be increased where all or a majority of trucks are approaching the maximum legal load.

The strength or thickness of the pavement is not directly proportional to the equivalent wheel load but is assumed to be in proportion to the traffic index which is now calculated as $1.35\ EWL^{0.11}$. The traffic index numbers then give a simple numerical scale which, for highway traffic, may range from three for lightly traveled residential streets to a maximum of 12 or 13 for the heaviest traveled industrial highways. The thickness of the pavement structure will vary directly with the Traffic Index.

Having arrived at a means for evaluating the traffic loads to be carried, the next step is to find out what the soil will support in order to estimate how much base and pavement will be needed.

It is not always realized, however, that the unit strength of virtually all materials varies with the size of the specimen and, in general, the smaller the specimen tested the higher the unit strength. Thus, the calculated strength in psi for finely drawn steel wires or glass strands

may seem extraordinarily high. Similarly, the supporting power of soils may vary considerably, depending upon the area under load. Cohesionless sands will show marked increase with increase in load area, but the same increase is not found in plastic clays. Thus it is difficult, if not impossible to predict, from a small test area the supporting power of soils under a large area. Furthermore, the concept of "strength" becomes troublesome when applied to many natural materials. One can measure strength by tests on solid rock, but not on a pile of sand. It seems that we must employ some other concept than strength when dealing with soils or uncemented granular materials. It is for this reason that we have adopted the term "Resistance Value" to indicate the ability of soils, sands, gravels, etc., to resist being distorted or pushed around.

Acting on the premise that the ability of soils to sustain pavements can be evaluated by means of the resistance value (R-value); that the combined effects of traffic may be reflected by a traffic index; and that the relative slab strength or tensile strength of pavement and base slabs may be assigned by means of Cohesiometer tests it is then possible to develop a formula from which the pavement thickness may be computed. Fig. 1 is a nomograph showing the relationships indicated. For reference, rough classifications of some common soil types have been placed on the chart. General descriptive terms for the various levels of traffic and examples of pavement strength values are also shown.

Pavement bases of crushed stone may give very good performance. However, if the stone is mixed with a cementing agent such as portland cement, for example, the engineer must be concerned with the crushing strength. If this crushing strength falls below one or two thousand psi, the average engineer is liable to be worried despite the fact that the best stone base that it is possible to build with natural materials is unlikely to develop as much as 75 psi when tested in the form of an unrestrained cylinder. Therefore, if an 8-in. crushed stone base can give a respectable performance under heavy traffic when protected by a 4-in. asphaltic pavement, it must be because of some property other than crushing strength as ordinarily conceived, and pertinent question is: What are the properties that are essential for a good base?

Many years ago, Dr. Strahan of Georgia[2] emphasized the importance of building "road slabs" which he accomplished by mixing certain red clays with gravel bases. Apparently, he obtained satisfactory results with the peculiar red clays of Georgia, but attempts of other engineers to follow his example led to disastrous and expensive failures in a large number of cases. It became evident that while clay admixtures might add to the slab strength and improve the cohesiveness, it was also adding something else on the debit side. Wet clay is a lubricant and lubrication means the reduction of friction. It becomes obvious, therefore, that the primary important property of granular or crushed stone bases is the interparticle friction, and any admixture that tends to reduce this interparticle friction will reduce the quality of the base and its ability to sustain loads.

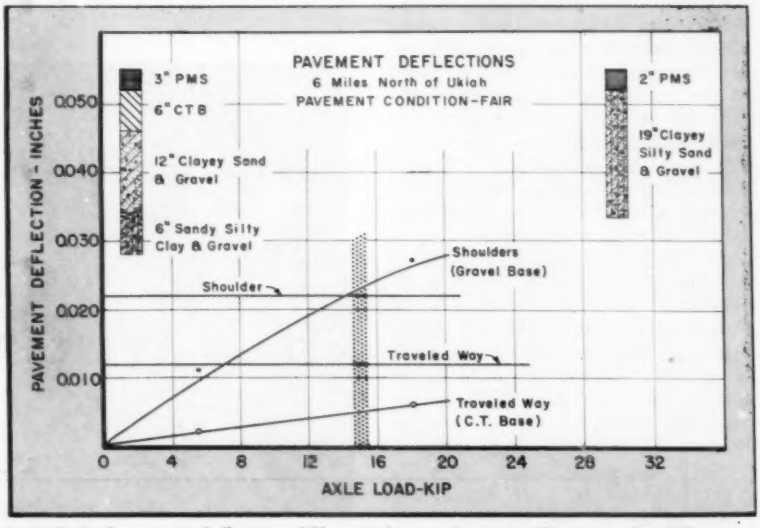
A layer of loose crushed stone or gravel will not stay in place when subjected to traffic and must be constantly maintained. It is simpler and much more convenient for the construction engineer to incorporate enough fine material which, when wetted and rolled, will cement the mass together, and the appearance is even more impressive if the soil binder is of a type that will bake hard when exposed to the sun and wind and furnish a sort of natural concrete often with a smooth, hard and almost dustless surface.

Experience indicates that the percentage of fine material in a granular base should be restricted and carefully controlled. The total amount of dust passing a No. 200 sieve should not exceed 8 percent based upon a wash analysis and the character of the fine fraction should be such that it will not have a sand equivalent value of less than 30.[3] These same principles will apply to subbases with somewhat greater tolerance possible.

Many engineers have turned to artificial binders in order to achieve some of the advantages of cemented bases without the uncertainties characteristic of natural binders. Among the more commonly used artificial binders are tar, asphalt, portland cement and lime with a variety of other substances used less frequently.

It can be shown that the ability of a base course to support the pavement is greater when the base possesses some slab strength. Fig. 2 illustrates the difference in pavement deflection over comparable soils where a cement treated base is compared to an untreated gravel base. California has used cement treated bases very extensively since 1939.

It appears that the improvement of natural materials could be roughly divided into two types. One is the addition of a material which would have some moderate binding effect and which would not be adversely affected by water. The second would involve the imparting of substantial tensile strength in order that the base would develop definite slab action. The thing to be avoided is any sort of lubrication. Lubrication of a gravel base can develop from several different sources—first, if an excessive amount of clay is added to the material at the time of construction and later becomes wet;



● **FIG. 2. Pavement deflection differentials are shown to illustrate the differences in deflection over comparable soils and loads for cement treated and gravel bases.**

second, if the aggregate degrades and produces fines that form plastic or lubricating films when wet; third, the underlying soil or clay may work up into a coarse or open stone base. Many miles of failed roads can be traced to the practice of placing relatively clean or open stone on a clay or silty subgrade. One of the most effective materials too often neglected is a layer of sand directly on the adverse soils. Both experience and laboratory tests have proved that sand is an effective barrier against the infiltration of clay.

Construction Methods

The questions of construction methods, type of equipment, etc., do not seem to require very much discussion. The vast majority of current specifications are quite adequate. It is not so much a question of how to write an adequate specification for a base course; the principal consideration today is whether or not the specification will be enforced. The precise gradation of stone for a crusher run base is often less important than the uniformity. The compaction of granular material is not difficult to achieve with modern equipment which includes vibrators as well as rollers and if the percentage of fines is rigidly maintained on the low side the moisture content for compaction is not particularly critical. In other words, present specifications for untreated bases, lime treated bases or cement treated bases are generally quite comprehensive and adequate. Good bases can be constructed by any of these methods if the specifications are enforced.

It is evident that successful pavement structures have been constructed with a wide variety of materials including relatively rigid slabs, stone blocks, crushed stone, gravel and even cohesionless sand in the lower courses, but it is difficult to compute or estimate the thickness required with any or all materials by means of a single formula. The manner in which a gravel or crushed stone base sustains wheel loads inevitably differs from the mechanics of a more or less monolithic slab. Work by A. T. Goldbeck[4] and by the Bureau of Public Roads[5] demonstrated many years ago that the ability of granular materials to support loads varies greatly with the area covered by the load. Materials such as crushed stone or sand having high internal friction characteristically show a great increase in unit supporting power as the area is increased, but the rate of such increase varies with the degree of lubrication so that when we reach the opposite extreme with wet clay or plastic soil there is very little increase with increasing load areas.

It would seem that this evidence would have long ago discouraged making simple plate bearing tests, at least with a single sized plate. And the same data explain one of the principal limitations of the CBR test. The use of plate bearing tests may have some justification when trying to evaluate the capacity of a pavement that has been in place for many years. It is a very unreliable method for evaluating new construction, especially granular bases, as in addition to the area variable it will be most difficult, if not next to impossible, to create the exact moisture and density conditions in a newly constructed base that would normally develop after many years beneath a pavement surface.

Perhaps in any discussion of pavement bases, this one point is probably the most important; namely, that the moisture-density equilibrium is not finally established until the passage of considerable time, often of several years. Any field tests made on a newly constructed base are likely to be misleading and unfortunately in the wrong direction. It appears that the only means available to the engineer is to prepare test specimens in the laboratory to duplicate the density and moisture content which may be expected to develop in a period of time, and the problem of preparing test specimens becomes the first and most important problem in realistic testing.

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5. C. A. Hogentogler, A. M. Wintermyer, E. A. Willis, "Subgrade Soil Constants, their Significance, and their Application in Practice," Public Roads, Vol. 12, No. 4, June 1931.

JOINT CLAMPS FOR A "STITCH IN TIME"

ALL TOO OFTEN city water departments find themselves faced with the necessity of tearing up recently laid pavements to effect necessary main repairs. Brigham City, Utah will not have that problem thanks to its foresighted City Council and water superintendent, Dallas Jeppson.

Early this year the Utah State Road Commission found it expedient to widen the Main street through Brigham City because it is a segment of the main highway, running north and south, which connects northern Utah with southern Idaho. Consequently, the traffic through Brigham City is heavy and includes all the truck transportation commuting between Salt Lake City and points in southern Idaho.

● JOINT clamps will protect main.

It was decided that any necessary repairs on the 10 and 12 inch water lines beneath the street should be made before paving was started. The 39 year old cast iron line had no leaks, it was found, but the ground immediately around the bells showed signs of iron oxide. To insure that the new pavement being laid would not have to be broken in the future to repair leaks, the City Council purchased 160 Dresser Style 60 Bell Joint Clamps.

The entire line was quickly and permanently clamped by 2 men working only eight 8-hour days. This included all the uncovering, cleaning and clamping. Keith Hansen, City Engineer, stated that he was very satisfied with the entire job and expressed the firm opinion that Brigham City will have now a smooth, unbroken main street for years to come.

MANHOLES Go MODERN *and* NOISELESS

WILLIAM W. TAYLOR,
President,
The Silent Knight Company,
Cincinnati, Ohio

IN THE SUMMER of 1954, the author, a graduate mechanical engineer, was kept awake by a rattling manhole in the street nearby. He decided that something should be done to get a permanent solution to the problem. An early step was a conference with C. A. Harrell, City Manager of Cincinnati, who stated that rattling manholes were a source of complaint in every city. He referred the matter to William Wichman, Director of Public Works, who, in turn, designated Charles Heidschuch, Supt. of Highway Maintenance, as the man with whom to work.

In the course of the work, a thorough search was made of the trade and patent literature. It was found that non-rattling manholes were not new and, in fact, have been in use in England for many years. One of the English manholes was imported and inspected by the highway department personnel, but it was rejected for the following reasons: (1) The lid was too heavy to be removed and replaced by one man; (2) there was nothing to stop the lid shifting on its seatings under the accelerating and braking forces of modern traffic, thus wearing the small seats into the frame; and (3) there was no possibility of shimming up the lid at resurfacing time.

With his design engineer, Paul S. Ward, the author developed one manhole after another. Eventually, after modifications made to meet Mr. Heidschuch's criticisms, it was agreed to go ahead and try two sample manholes. These were installed in May, 1956, on U.S. Truck Route 50, one at State Avenue and the other at Maryland Avenue. These locations were selected as representing the most severe traffic loads to be found in the city.

Throughout the following months, the sewer maintenance department under Harvey Roland, Sr., kept the manholes under periodic checks to make sure they were functioning in a satisfactory manner. By early 1957, Mr. Heidschuch expressed verbal satisfaction with the performance of the manholes and suggested that all interested groups should be called together for a conference. After some delays, the project was discussed in June with Mr. Wichman; the City Engineer, T. J. Montgomery; and his assistant in charge of sewers, A. H. Buck. At this time, final changes were made to satisfy the requirements of all concerned and the city agreed to go ahead and order a quantity of 23-in. manholes.

Immediately the villages of Fairfax and Blue Ash, two communities in the Cincinnati Metropolitan area, which were at that time considering new sewer projects, accepted the design as representing a major advance in manhole covers and specified them for the new work.

What does this manhole look like? The lid is bisected along the diagonal to form two triangles. Each has three-point support which is what makes the lid non-rattling. Whenever a tire contacts the lid, it is bound to be inside the lines of support, where it cannot lift the lid. In fact, the harder the tire hits, the more securely does the lid hug its supports.

Why is it impossible to wear the lid support surfaces? Each support lug is wedge shaped and fits into a vee support on the frame. The four vee supports cast in line with the diagonal prevent any lid motion at right angles to the diagonal. The two remaining vee supports prevent any lid motion in the direction of the diagonal. This "crossed vee" support locks the lid securely against any movement whatsoever, whether caused by traffic acceleration, braking, side sway, or wheel bounce. Inspection of the lugs of the two manholes after they had been under heavy traffic conditions for one year showed no evidence of any wear whatsoever.

● **MANHOLE cover will not rattle under traffic nor fall through manhole opening.**

So that the two halves of the lid cannot separate and fall down the hole, they are tied together by two rods passing through loose fit holes in the four cross webs underneath the lid. When assembled it is impossible for the lid to pass through the hole in the masonry.

The clamping bolts pass through both shim and frame. Recesses under the support vees in the frame accommodate the nuts and lock washers. A suitable expanding grout is required under the horizontal straps of the shim only. Shims may be of any height, from ¾-in. minimum, and may be added one on top of another as the street is successively resurfaced.

Arrangements are now under way to license any foundry that wishes to manufacture Silent Knight Manholes and to get them distributed on a national basis. This manhole can never rattle; the lid support surfaces cannot wear; and the lid can be shimmed up at any time to any desired height.

CITY-COUNTY CONTROL OF

A. ANNE DUNBAR,
Supervising Sanitarian,
and
JOSEPH J. WEINSTEIN, M.C.E.,
Sanitary Engineer,
Health Department,
Maricopa County, Arizona

MARICOPA COUNTY, in South Central Arizona, comprises some 9,000 square miles of area and has a population of 502,000, with about 320,000 individuals in the Greater Phoenix area. The remainder are scattered throughout the county in 10 or 12 smaller communities and on numerous farms and ranches. The City of Phoenix Health Department, which has hitherto functioned separately from that of the county, was merged with the County Health Department July 1, 1957.

Phoenix is one of the fastest growing cities in the United States. In the last five years it has more than doubled its area. Its population has increased by 62 percent and it is still growing. The rapid increase in area and population has been accomplished to a great extent by annexation of contiguous land in the county. The county, therefore, has the responsibility for assuring to the city that the homes and subdivisions acquired in these annexation proceedings are properly and adequately equipped with approved individual sewage disposal systems, leaving to the city only the need for taking the next step, the provision of sewers.

Because growth has been so explosively rapid, community services such as municipal water and sewer systems have not been able to keep pace. Thus more than 70 percent of the subdivision homes located within the city and county are dependent upon individual sewage disposal systems. This 70 percent represents about 25,000 homes which discharge roughly 15,000,000 gallons of sewage per day. From these figures it should be apparent that the responsibility for the prevention of sewage-borne health hazards is great.

Coupled with the volume of sewage are technical soil problems affecting the design and construction of the system most likely to be installed. For the most part the county is an ancient flood plain desert country, with extensive mountainous outcrops, much of which has been reclaimed through flood irrigation. The soils encountered contain silt, clay, sand, decomposed granite, hard pan and caliche. The caliche governs to a great extent the type of sewage disposal system to be installed. Caliche is a clay containing fine natural cement which is sealed, or seals like concrete in the presence of water. Disposal fields of leaching lines do not function well in this type soil, but may function above it. The alternative is the seepage pit drilled through the caliche into a sand or gravel formation which will permit adequate percolation. Such a seepage pit will vary in depth from 15 to 110 feet. In a community located in the Northeast section of the county there are seepage pits located across the street from each other, not more than 150 feet apart, one of which exhibited good percolation qualities at 18 feet, while the other was drilled through solid caliche to a depth of 98 feet before good percolation soil was encountered. In some sections of the county, the underground formations vary so sharply that percolation tests are a necessity in every lot. However, in subdivisions in the level areas of the county there is sufficient uniformity of sub-soil conditions to permit percolation tests at the rate of 1 in each 5 lots where seepage pits are involved. Flood irrigation of lawns and gardens is another factor which makes the use of leaching lines impractical and difficult.

Generally speaking, in other counties in Arizona, seepage pits are considered objectionable. In Maricopa County, however, they are a necessary evil. As a result of the widespread use of these pits there is constant danger from the possibility of ground water pollution or cave-ins. In one section which contains about eight or nine large subdivisions covering an area of some four or five square miles, ground water is encountered from 12 feet below grade down to 30 feet. Many seepage pits had been drilled into this ground water, and were approved for sewage disposal before the county commenced its supervisory program. Authorities have stated that this water is not potable, has never been used for domestic purposes, and that there need be no concern about it. While we disagree we have had little alternative but to permit the continuance of an accomplished situation. The seepage pits function well, since the sewage is carried away by this underground stream of water. Nonetheless, a constant watch is kept for domestic wells which might be drilled within the area or close enough to it to be affected. Surveillance is maintained over the bacteriological quality of wells located near any subdivision. No connection between bacteriologically unsafe water and subdivision sewage has yet been found but the threat is always present. Cave-ins have occurred, sometimes with tragic result. The chief weapon against them is more diligent inspection, better regulation and closer supervision of the artisans engaged in installation work.

● SEEPAGE pits are 15 to 110 ft. deep. Sometimes they fail by caving.

This, then is the picture—a great number of individual sewage disposal systems in operation, many more going in, and unique problems of design, construction and planning with which the Maricopa County Health Department must deal in order to assure to the populace the public health protection it requires.

Subdivision Sewage Inspections

What has been done about it? In January, 1955, the Maricopa County Health Department, realizing that these systems were not being inspected by any public health agency, requested responsibility for inspection and approval of all subdivision homes sponsored by the F.H.A. and V.A. agencies. This was bequeathed with alacrity, and without either de-

bate or instruction. It was the first time that the county health department had ever entered the field of subdivision sewage inspections. The total staff consisted of seven field sanitarians, two of whom were on special assignments, and the Sanitary Engineer. When we received the files of 182 active subdivisions, each one containing an average of seventy homes, it looked like a staggering load. One sanitarian was assigned exclusively to the field work and Miss Dunbar was given supervisory responsibility for the program. It was a matter of "learning by doing", and a female supervisor in the field did not help at first. Mistakes were made but also solid progress.

Lacking detailed state or county regulations on sewage disposal, reliance was first placed almost entirely on the minimum standards set forth by F.H.A. and V.A. These standards were written to apply to the entire state of Arizona and it was necessary to interpret them in the light of the county's peculiar problems. For instance, the minimum lot size established by the County Planning and Zoning Commission is only 6,000 square feet. Land values being what they are the builder tends to put the largest possible house on the smallest possible lot. This crowds the sewage disposal system into the absolute minimum of space. It frequently happens that the building contractor will pour the foundation and stub out the plumbing before the disposal system contractor is called in on the job. When he arrives he finds that he has not been allowed enough space between the foundation of the house and the lot lines to install the septic tank, distribution box and seepage pits as required. Another hindrance arises when power lines are erected too early in the easement or alley way of a new subdivision, making it impossible for the driller to move his rig in underneath them to drill the pit where required within the lot.

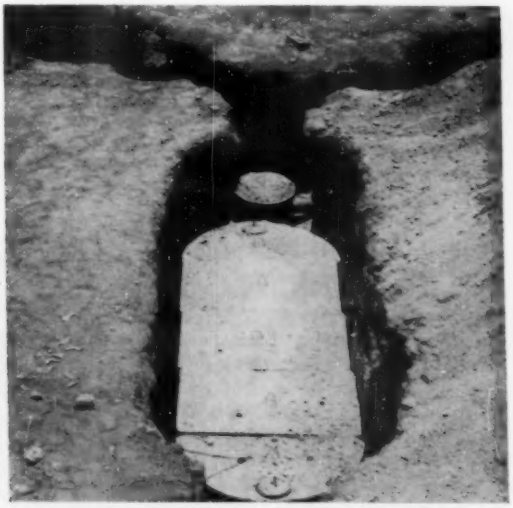
Occasionally it was necessary to allow exceptions to the F.H.A. and V.A. rules, particularly with relation to proximity to lot lines and foundations. In making any exceptions, consideration is given to the effect on the soundness of the installation and the problems that may arise for the prospective buyer of the property. For instance, if a seepage pit is drilled too close to an alley way it may be subject to impact and bearing stresses from garbage trucks and other heavy vehicles that use the alley for utility purposes. The life of the seepage pit would be shortened appreciably if it caved to any extent as a result of these heavy loads. Another consideration is the location of the septic tank. If it is installed too close to the house foundation, settling of the ground under the weight of the structure or bearing stresses may cause the septic tank to shift and settle. Adequate separation of the seepage pit and the septic tank is also important. It is felt that pits should be a minimum of three diameters from the septic tank. Inspections have disclosed that in almost every case where a septic tank has tilted and broken connecting lines, this occurred at the effluent end of the septic tank. It appears that this results from the weakening of the soil structure by percolation from a seepage pit located too close to a tank.

From time to time an almost unbelievable situation is encountered —a septic tank installed backwards so that the sewage tends to back up into the house rather than drain out into the seepage pit. In the early days of our activities in subdivisions we checked one in which about 50 houses were nearing completion. We found that 22 septic tanks had been installed and connected, which were all one size too small for the number of bedrooms in the houses. There followed the unpleasant job of requiring the builder to remove these small tanks and replace them with those of adequate size.

Comprehensive Regulation

We have been active in this subdivision work only a little more than two years, but our fame (or our infamy) has spread throughout the county. More and more fre-

● **PRE-CAST concrete septic tank is being lowered into its excavation; 25,000 homes in Maricopa County rely on septic tanks.**



● **PRECAST septic tank with sectional cover which is grouted in place. Note there are two seepage pits.**

● **PERCOLATION test is now the basis for the design of a septic tank installation. Soil formations vary so that establishment of a pattern is difficult. Here a sanitarian is making the necessary percolation measurements for installing a seepage pit.**

quently we are called upon to approve sewage disposal installations for homes which are privately financed or which are financed through conventional loans from a mortgage company or bank. These requests are welcomed because we feel that in preventing the installation of even a single sub-standard system, we will have saved trouble and expense for all concerned. Special requests have been coming in with increasing frequency, urging us to greater speed in developing a comprehensive sewage disposal regulation for Maricopa County. We have written and re-written such a regulation, a rather long voluminous document. Two public hearings were held and the drillers, contractors, and other agencies interested were invited to present their criticisms and suggestions for improving the regulation and making it workable for the county. In writing this regulation we drew from standards of the United States Public Health Service, the rules of F.H.A. and V.A., regulations in use in other states and most of all from experience with local conditions in our county. Regulatory provisions had to be applicable not only to the urban areas, but also to homes built by individuals far out on the desert. The regulation has now reached its final form and is awaiting approval by the Board of Health.

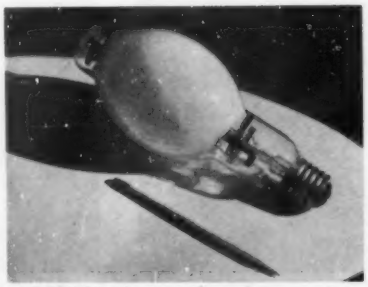
On March 1st of this year, the F.H.A. and V.A. discontinued their sewage system inspection services and turned all sewage disposal inspections over to our department. Now instead of checking representative lots in the subdivisions we must make a full technical inspection on every installation. These inspections are handled by district sanitarians, whose numbers have been increased. When our sewage disposal regulation becomes effective, we will issue permits for all installations. This will add greatly to control not only of tract homes, but of individual homes, the industrial and other installations. In public relations work the builders are urged to design plumbing installations so that they may be readily and economically connected to a public sewer system when such a system becomes available. They are also urged to provide each home buyer with a plot plan of the lot showing the exact location of all utilities, particularly the sewage disposal system. When such drawings are available, much time, labor and expense can be saved in servicing these units. The aim in each and every step taken in the past two years has been to afford protection to the public and to give assurance to home owners and industrial builders that septic tank and seepage pit systems will operate safely and adequately.

NEW LAMP
CUTS STREET LIGHTING COSTS

PHIL HIRSCH

A RECENTLY-developed fluorescent mercury vapor lamp, which operates without a ballast on a 6.6-amp series circuit, has substantially cut costs of a new street lighting installation in Crown Point, Ind. The Lamp (Model B-H24) is manufactured by Westinghouse.

Crown Point, like many communities, used incandescent illumination for years. The city's lights were fed from a conventional 6.6-amp series circuit, which was connected to a constant current transformer (with an input, in this case, of 2400 volts from a diesel-electric generator). Since mercury vapor street lamps usually are rated at 3.3 amps, explains Mayor Marvin G. Erlenbach, the switch to this type of illumination would have necessitated one of two changes in the circuits: either a) a new transformer, providing 3.3 amps on the output side; or b) installation of ballasts capable of cutting the 6.6-



● **B-H24 fluorescent mercury vapor lamp which was used at Crown Point.**

amp line current in half before it reached the mercury vapor lamp's arc tube.

Either alternative would have been costly. Crown Point's new street light installation consists of 77 fluorescent mercury vapor lamps, erected in the downtown area and nearby residential sections. Cost of ballasts would have been about $55 per lamp, or a total of about $4,200. The expense of installing the ballasts would have raised this figure to $5,000. Cost of the whole street lighting installation came to approximately $40,000. Thus, the $5,000 saving represents about 12% of the total investment.

If new transformers had been installed, instead of ballasts, the cost would have been almost as high.

At the time the fluorescent mercury vapor luminaires were installed, Crown Point had approximately 400 street lights in operation, all of them incandescent. About half of these were mounted on electric poles and connected to lines of the Northwestern Indiana Public Service Co. The remainder, comprising 205 units, were mounted on 12-ft. cast iron standards and supplied with power from three series circuits; each circuit was energized by a constant-current transformer fed from diesel-electric generators located in Crown Point's municipal power plant. One transformer was rated at 10 kw., while the others were each 20-kw. units.

When the switch to mercury vapor luminaires was made, additional power was needed, so a fourth constant-current transformer was installed, rated at 30 kw. This extra transformer would have been needed, explains Mayor Erlenbach, regardless of the type of mercury vapor lamp employed. "But, with a 3.3-amp lamp, we would have had to replace the three existing transformers as well. Thus by using a unit rated at 6.6 amps, we saved this latter expense. We have been told that it would have amounted to at least $3,600 — i.e. $1200 for each transformer—or, nearly 10 percent of the total cost of the project."

Installation of Crown Point's new street lights was financed by funds derived from operation of the city's power plant and there was only a fixed amount to spend on the project. Thus, by cutting overall costs, more lights were put up, and a greater area of the city was covered than would have been possible otherwise.

The decision to use mercury vapor luminaires was made after a careful appraisal of all light sources available. Although the final choice required a 30-kw. increase in the power supply, the benefits—in terms of increased illumination level — were considered more than sufficient to justify this increase.

A big advantage of mercury vapor illumination, Crown Point officials explain, is that it is a much more efficient light source than incandescent-type lamps. The latter produce 20 lumens per watt, while the B-H24 — the mercury-vapor lamp used in the Crown Point installation —is rated at 50 lumens/watt. Also, the luminaire used on this installation (Westinghouse Model OV-20-S) is 75 percent efficient; the incandescent fixture formerly employed was only about 50 percent efficient. As a result of these two factors, average maintained illumination in the areas where the new lights have been installed is 1.6 fc. By comparison, these areas had only 0.3 to 0.4 fc. of illumination when the incandescents were in use. In other words, by increasing the power input 60 percent, from 50 to 80 kw., Crown Point officials were able to provide residents with four times as much illumination in the areas where the new street lights were installed.

Additional savings stem from the reduced expense involved in maintaining the mercury vapor lamps, Mayor Erlenbach points out. It costs Crown Point approximately $5 for labor to replace a burned-out lamp. The mercury-vapor unit has a rated service life of 6-8,000 hours, while the old incandescent units were good for about 1,000 operating hours. Thus, for every $30 to $40 spent on maintenance of the latter lamps, only $5 is required for the new ones. Mercury vapor lamps cost about $12 apiece. The cost of incandescent bulbs capable of providing the same service life is $6 to $8. This cost differential is more than balanced, however, by the reduction in maintenance labor costs.

Crown Point's 77 new mercury-vapor luminaires are installed along 22 blocks of the city's downtown and residential areas. Previously, these sections were served by 132 incandescent units.

The mercury-vapor lights are mounted on 27-ft. prestressed concrete standards (model 800-B27-H6) manufactured by American Concrete Corp., Chicago. These standards have unusually high strength, reports Mayor Erlenbach. Recently, one of the new poles suffered only minor damage after it was struck by a car traveling approximately 40 mph.

The new lights are placed on both sides of the street in the downtown area, and on some residential blocks, while on other blocks lights are placed on only one side of the street. Spacing in the former case is 85 ft. (staggered), and 135 ft. in the latter.

The installation was completed early in the summer of 1957, and it isn't possible to measure the effects yet in terms of reduced accidents. However, Crown Point merchants are particularly pleased with the higher illumination level in the downtown area. A number have reported increased business at night since the mercury-vapor lights were turned on.

● **LIGHTS operate off a 6.6-amp series circuit without the need for ballasts.**

REFUSE COLLECTION by Packer-Type Vehicles: *ECONOMIES and PRACTICES*

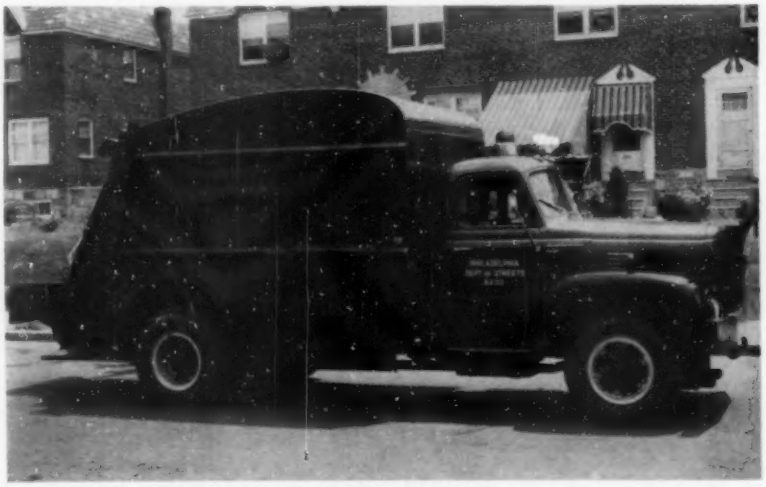
IN ORDER to obtain data on the usage, sizes, economies and general utility of packer-type refuse collection vehicles, a questionnaire was sent to many of the cities with a population exceeding 100,000. This form requested data on the number and size of units; weight of refuse carried; preferred capacity; pickups made per unit and per day and location of pickup; size of crew; length of route; truck cleaning practices; and savings from the use of the packer-type as compared to open-body trucks. The data are summarized in this article. A later article will cover essentially the same factors for cities in a smaller population bracket.

Collection Data

There is no fixed point of collection. Of 31 replies, 10 were reported as alleys, 9 as backdoor and 12 as curb. However, some cities provide all three services, depending on the material collected and the type of service, as residential.

Frequency of collection was not covered in the questionnaire. However, the replies indicated that collections were normally, in most cases, made twice a week.

An attempt was made to get information on the number of pickups made each day by a unit. Much depends on the frequency of collection and on the type of material collected. Obviously, if all types of refuse are collected at one time and two collections a week are made, fewer pickups are possible than if only garbage is collected. The reply from St. Louis illustrates this. Mr. Deering reports the average length of collection routes is 900 family units for rubbish, using 15-yd. packers and 2600 family units for garbage, using 9 and 10-yd. packers. Mr. Schink of Detroit reports 300 to 600 stops per day in garbage collection and 175 to 400 stops per day in rubbish collection. Of the 456 packer type trucks used in Detroit, 219 are of 16-yd. capacity, 138 are 15-yd.. 88 are 12-yd. and 11 are of miscellaneous capacities. He reports the weight of wrapped garbage averages 5.3 tons per unit daily; rubbish, ashes, etc., are not weighed.



● **16-YARD unit shown is typical of Philadelphia's fleet of 373 modern collectors.**

Courtesy Malsbary Mfg. Co.

● **STEAM cleaning and daily hosing are used in Hartford, Conn., for cleaning refuse collection vehicles. Data on similar practices in other cities are also summarized.**

Based on an average production of all kinds of refuse of 2.7 pounds per person and a family of 4.2 persons, the average daily production will be 11.3 pounds per family per day or about 80 pounds per week. With two collections per week, the average collection will be 40 pounds.

Per Capita Use and Preferred Sizes

Nearly 4,000 packer units are represented in the reports from 40 cities of 100,000 population and larger. Using the 1950 census population as a basis, the units per 100,000 population vary from a minimum of 3.0 to a maximum of 33.2. The average is 14.7 units per 100,000 and a considerable number of cities

were near this figure. Much depends on such factors as the types of refuse collected; the use of private collectors; employment of open body trucks for certain types of wastes; the number of "extras" on hand; and, to some extent, on the frequency of collection and the area to be served. An attempt was made to include the effect of area served, but data were inadequate to provide any reliable picture.

Sizes of packer trucks were reported from 6-yd. by Philadelphia up to 20-yd. by many cities. The small units used by Philadelphia are employed on alleys where space is restricted. Youngstown, O., is limited to 9-yd. trucks by the height of the doors at the incinerator.

Based on reports from a good many cities, the pay load is very close to 500 pounds per cu. yd. of

● **PACKER truck used in Atlanta, Ga., is estimated to save $16,000 per year/route.**

● **NEWEST of the packer-type bodies received by Houston. More are on order.**

body capacity. That is, for a 20-yd. vehicle, the pay load will be close to 10,000 lbs.; for a 15-yd. body, it will be about 7500 lbs.; and for a 12-yd., very close to 6,000 lbs. There were only a few considerable divergencies reported from these figures.

Preferences as to size of body were reported by 30 cities. Of these, 9 preferred the 20-yd. units while 14 selected the 16-yd. bodies. The trend was quite emphatically for the larger units. A considerable number of units were reported "on order" and these were almost invariably 20-yd. or 16-yd.

Savings from Use of Packer Trucks

Little Rock, Ark., Curtis E. Woods, Director of Sanitation, reports a 50 percent saving over open trucks. Hartford, Conn., L. C. Lovell, Director of Public Works, estimates savings in use of packer trucks in Hartford amount to $20 to $25 per day. Waterbury, Conn., Walter Kunsch, Sup't., Waste Treatment Plant, says there has been no opportunity for estimating savings because packer type trucks have been used ever since municipal collections began in 1952. Atlanta, Ga., John W. Ball, Sanitary Engineer, estimates that the use of packer trucks reduces costs about $16,000 annually per route covered.

Lynn, Mass., Thomas D. Barry, Sup't of Sanitary Department, estimates the savings are equal to one man on each truck. Lynn used 11 packer type and 9 open body trucks and usually runs the 11 packers and 8 of the open the first three days of the week and reduces open truck usage the other two days. Garbage is collected separately from rubbish; no residue is accepted from industry and four barrels are allowed from commercial houses.

Somerville, Mass., Walter J. Manning, Actg. Supt., Sanitary Dep't., estimates manpower savings from the use of packer trucks at $43,585 per year. The fleet of 12 16-yd. closed body automatic packers reduced manpower requirements by 20 men as compared to 14 12-yd. open trucks. Flint, Mich., H. C. Clapp, supervisor of Waste Collection, reports "there is definitely a saving" but cannot give exact figures.

Omaha, Nebr., H. H. Ulrich, Director of Sanitation, estimates savings at 35 percent or about $50 per collection route. New York, N. Y., Henry Liebman, Director of Operations, Dep't. of Sanitation, reports no experience with open trucks since 1931, but estimates a packer truck carries 1½ to 2½ times the equivalent open body volume. Youngstown, O., M. A. Bacha, Sup't., City Incinerator, estimates the savings for packer type trucks at 25 to 30 percent. Philadelphia, Pa., William W. Griffin, Deputy Commissioner, Dep't. of Streets, reports "our experience has been that the ratio of efficiency of compactor trucks over open trucks has worked out to be three to four." Houston, Texas, Geo. D. Fredricks, Sup't., Garbage Division, states that packer type trucks collect twice as much garbage as open bed; savings amount to about $40 per day per route.

Salt Lake City, Utah, M. C. Denhalter, Budget Director, says that one of their 12-yd. packer-type units (the city has 22 12-yd. and 7 16-yd.) will handle up to three or

(*Continued on page* 126)

ENGINEERING MAN-HOURS SAVED WITH ELECTRONIC COMPUTERS

JOHN F. MANNIX,

Senior Program Engineer,
Texas Highway Department

THE TEXAS Highway Department has been using an IBM 650 electronic computer for approximately twelve months. During this time work has progressed toward developing programs and gradually expanding the productive output of the computer. The major portion of the productive time of the computer is devoted to the normal routine work of solving traverses, computing bridges, extending bids for letting, and performing earthwork computations. In these fields an appreciable saving of engineering time can be shown and in some cases the amount of time saved is quite substantial. In all cases the results are accurate and as dependable as the information on which the calculations are based.

Other productive work of a non-routine nature has been devoted to the preparation of tables and the calculation of stresses in concrete slabs using Westergaard's and Pickett's equations. A table of tangent offsets for laying out a horizontal curve, and a vertical curve table for determining the vertical offsets from two different grade lines have been distributed to district offices throughout the state. Use of these tables saves an undetermined amount of time.

Application of the computer for solving traverses is steadily increasing. Although most traverse problems normally encountered are not difficult, they represent a tedious routine which the average person is glad to avoid after they have had a few traverses solved on the computer.

The time saved in solving traverses with the computer is difficult to determine because of the wide range in time spent solving these traverses by hand methods. It may require a half a day or more to obtain a correct solution for a difficult traverse including curved portions. The same traverse is solved accurately in less than half a minute on the machine. Complete processing time, including preparation of cards from special forms on which the field notes have been transcribed and listing results on printed forms, may take a total of five minutes time. Most traverses calculated by hand require less than four hours to solve; however, it would require diligence and a degree of skill beyond that of most individuals to maintain a five minute average per traverse on all traverses normally encountered in the average highway engineering office. A conservative estimate of the time ratio in solving traverses is 60 to 1. This figure is based on the assumption that the time spent on solving all traverses using hand methods averages about 30 minutes for each traverse.

● **CLASS at district office to acquaint engineers with computer input data and information available from output.**

● **FRONT to rear: Wiring a panel; programming a hydraulic problem; the author discussing a traffic light problem.**

Extending Bid Proposals

An application of the computer which is normally not considered when speaking of engineering applications is extending bid proposals for highway construction. The Texas Highway Department lets bids on two consecutive days of each month. Starting at 9 a.m., the bids are opened and read aloud. This usually

lasts until about 2 p.m. As the bids are read they are recorded and then extended and compared to determine the low bidder.

Formerly during the letting a major portion of the engineering personnel in the building was occupied for these two days with the letting. Thus, a large amount of engineering time was spent merely in computing the bids. Each item was extended, the columns totaled for each bidder, and the results checked for errors by a team of 4 people composed of engineers and administrative personnel. The individual extensions and column totals were then compared with the engineer's estimate to determine the percent of over-run or under-run. An average of 50 man-days was required to perform these calculations. The same calculations are now performed by 5 non-engineering people for a total of 5 man-days. The finished product is listed on a printed form with carbons, furnishing 3 accurate, legible copies.

A more direct comparison of the time required by each method may be made by considering an average contract to contain about 40 items with 6 bidders. About 20 minutes are required to punch the cards, 3 minutes are taken in computation, and 7 minutes are needed for handling and listing the extended bids. The total time spent is 1/2 man-hour. The same operation using desk calculators would require 4 individuals working three or more hours for a total of 12 man-hours. This ratio is 24 to one; however, the actual computing time is 240 to one.

The present method of handling the bids differs from the former method only in that the computations are performed on the electronic computer instead of desk calculators. The preparation of the information for computation and the verification of the bid items are still the same.

In addition to the three copies of the extensions required on the day of the letting, extra copies are distributed to various agencies. In some cases as many as fifteen copies are required. Since these copies are the same as those made on the actual day of the letting, considerable time is saved by using the punched cards of the letting. Previously it required four typists 3 1/2 days to type and proof all the extra copies, a total of 14 man-days. This is now done by one person in two days, a total of two man-days. Proofreading is unnecessary because the final copies are prepared from cards previously verified on the day of letting.

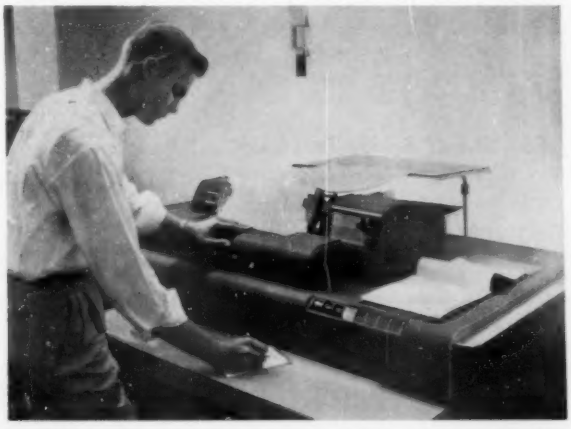
A further reduction in the time and personnel required to process the bids on the day of the letting is being planned. Reducing the time and personnel requirements increases the computer efficiency and results in an increase in the ratio of man-hours saved.

The first step in this direction is to reduce the number of key punch operators required to transcribe the bids to punched cards. At the present time the unit bids are ten digits in size of which only two or three digits are non-zero. The time required to prepare a unit bid card can be reduced by eliminating the zero key strokes. This can be accomplished by the addition to the keypunch of an auxiliary duplicating device. The 650 program has been modified to accept a card in which the key punch operator has punched a digit to indicate the decimal point location, followed by the two or three digits of the bid. The rest of the field has been filled in with zeros by the auxiliary duplicating device. The total number of key strokes required to punch the bids into cards has been reduced by more than one half. The number of keypunch operators needed to keep up with the letting will therefore also be reduced.

The second step in making more efficient use of the computer is to use it for other problems on the day of the letting in addition to doing the letting. This can be accomplished by properly scheduling time on the computer. At present during the letting the computer is used exclusively for extending the bids; however, only a very small portion of the computer time is necessary to perform the calculations. An hour and a half of computer time is sufficient to extend all the bids including reruns for corrections.

The corrections are not due to computer errors but due to errors in reading, recording, or punching the cards. These errors are detected by teams proofing the printed output of the computer against the contractors bid proposals. Bids with errors are returned to the computer group where the cards are corrected and then re-run.

● **AFTER programs have been prepared, the data are transcribed to punched cards by operators in key punch room.**



● **TIME-savings by using a computer are great. In the article examples of savings on common problems are enumerated.**

Earthwork Problems

A time study of the earthwork program is difficult to evaluate because of the many different operations and the variety of personnel involved. The time required to compute earthwork quantities and slope stakes for a mile of road is approximately ten minutes. To keypunch and verify design cross section cards for a mile of road requires about 1½ hours. The original cross sections

are recorded by surveying parties on mark sense cards which are reproduced into a second set of punched cards at the rate of 10 minutes per mile. A listing of the mark sense cards is returned to the sender for verification and filing.

The second set of calculations uses the original cross section plus the design cross section data. The results obtained are slope stakes, cut, fill, adjusted fill, and mass haul diagram ordinates. A study of the mass haul diagram ordinates at this stage may indicate a need for adjusting the grade. This can be done quickly, and the calculations should be repeated until a satisfactory solution has been obtained. It is recommended that this approach be taken into account during design thereby eliminating considerable time spent in trying to pick a satisfactory grade the first time.

After the grade and cross section design have been determined, the construction staking data is calculated. About 5 minutes are required to arrange the cards in the correct sequence, 2 minutes to calculate the staking information and 3 minutes to list the results on a printed form. The total amount of time required to process completely a mile of road is less than two hours. These same calculations require an average of 50 man-days to perform by hand. These figures indicate a ration of 200 to 1 in time saved.

Solution of Bridge Problems Saves Most Time

The most spectacular saving of engineering time has resulted from the programs which have been written for the solution of problems arising in the design of bridges. These programs are for bridges on a horizontal curve with vertical curve and super-elevation, and straight bridges with vertical curve and skewed bents.

To compute the necessary bridge geometry such as beam lengths, beam spacings, bearing seat elevations, etc., with a desk calculator may require from three weeks to six months. The identical calculations are performed in a minimum of 1 minute to a maximum of 20 minutes time on the computer. Transcribing the necessary data for the solution of a bridge problem into cards used as input to the computer and then listing the results calculated by the computer may increase this time to a maximum total of 45 minutes. The time required completely to process a bridge through the computer center depends more on the type of bridge rather than the length and number of bents.

A calculation using the above figures will show that the ratio of engineer's time to computer time will range from several hundred to one, to more than a thousand to one. Other programs which we anticipate using in the future for design of beams and bents are expected to yield similar savings of engineering time.

Use of the computer results in an increase in the quantity and quality of work produced by an engineering group. On the basis of the preceding figures the increased quantity is evident. Good design frequently requires that certain design factors be changed and a complete set of calculations be made for each change. Improving the quality of a design by trial and error using hand methods is usually prohibitive due to the excessive amount of time required. Only a few trial and error solutions can be made when it is absolutely necessary to derive more than one answer. This restriction has the effect of causing the engineer to spend time in trying to choose design factors more carefully to minimize the total number of trial problems. In complex situations this becomes an almost hopeless task and the engineer resorts to his "engineering judgment" in choosing design factors. Such designs may not be the most economic and in terms of quality not the best.

● **MODIFYING a control panel to accommodate a card change format.**

The principal increase in quality is the result of the ability to obtain a variety of solutions for a variety of design factors. The speed of the computer gives the engineer an opportunity to submit as many sets of design factors and obtain as many solutions as he may need. A choice of the most desirable solutions can then be made. Another increase in quality is due in a small part to the elimination of mathematical errors. Solving problems in this manner allows the engineer to change design factors in various combinations and thereby approximate more closely a solution considered ideal.

The question of the cost of maintaining a computer installation is frequently raised with the idea in mind that a significant reduction in the budget should follow shortly after organizing such a section. The effect is apparent not in a reduced budget but in lower design costs which result from the engineer's increased productive capacity.

Analysis of Costs

For a quantitative analysis of cost, consider the monthly rate of such a computer installation to be $10,000. This includes equipment rental, salaries, utilities, etc. At a rate of 20 working days per month and a computer efficiency figure of 100 (i.e. one hour computer time is equivalent to 100 hours on a desk calculator) the total number of hours amounts to 16,000. If we assume an engineer's salary to be 3 dollars an hour, then the 16,000 hours is worth $48,000. Therefore just to pay for itself, the computer need only be used 20 percent of the time. Any use above this time is profit. With the cooperation of the participating engineers, it should be possible to keep the computer occupied with productive work 80 percent of the time.

Another way of estimating the cost is to consider the computer time to be worth 62½¢ an hour. This figure is derived by dividing $10,000 by 16,000 hours. On this basis it can be seen that any routine computation should be scheduled for the computer whenever possible rather than for an engineer.

The figure of 100 chosen for computer efficiency is conservative and future development in uses of the computer for highway engineering applications will increase this figure still more. A figure of 200 or greater seems attainable with a resulting overall decrease in computer costs.

I would like to draw attention to the fact that at the present time the surface of this new concept has been but slightly scored. Only the most obvious applications are being exploited. Even the equipment we are now using and the present techniques of writing programs will be quite outmoded. This has already taken place in the past few years. As more people become involved in the various phases of this field the rate at which improvements develop will increase. Delay of the profession to take advantage of electronic computations will prove very quickly to be a costly mistake.

COLORFUL CERAMIC MURALS
Depict WATER TREATMENT

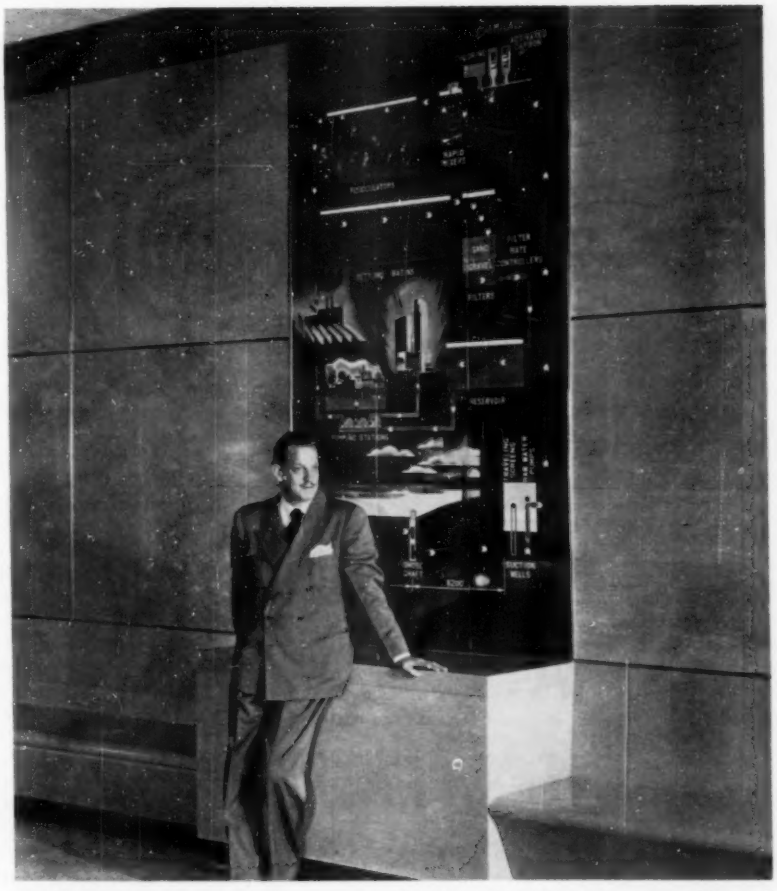
WORKING with vitreous enamels on steel panels, Artist H. Edward Winter has produced two colorful murals for the walls of the Administration Building of Cleveland's Nottingham Filtration Plant. Each mural is made in fifteen sections, measures 8 ft. 6 ins. in height and 5 ft. in width, and weighs 150 pounds.

One of the murals in the Nottingham plant traces the passage of water from the source through pumps and treatment units to the ultimate consumers in homes, offices and factories. The companion mural gives a map of Cleveland and its suburbs that are serviced by the plant, plus a schematic layout of the plant itself.

The architectural firm of Small, Smith and Reeb selected enamel as a medium for the murals since its clean surface would be consistent with the pink Tennessee marble walls of the plant's Administration Building. In addition, vitreous enamel has a great color and design range, making it especially adaptable to diagrammatic layouts.

To create these murals, the artist first makes a preliminary color sketch. This, in turn, is duplicated by a full-size drawing. Templates are then cut from heavy paper and the openings used to apply the porcelain enamel, which is in the consistency of heavy cream. After each part of the design is applied the section is fired three minutes at 1,500°F to make it permanent for further color application. Several firings were required in producing the Nottingham Plant murals.

Mr. Winter pioneered the use of this medium in Cleveland after study in Vienna, Austria, in 1931. In producing the murals he uses the facilities of the Ferro Corporation in Cleveland, working at nights in their development laboratory as a free lance artist. He has executed approximately 70 murals to date, and examples of his work are to be found in churches, public and private buildings and a number of museums. At present he is engaged in a 120-ft. square sectional mural for the Clague Road Filtration Plant in Cleveland. With this background, the artist says, he has become almost a specialist in public works decorations.



● **ONE OF the two ceramic murals displayed in the Administration Building of Cleveland's Nottingham Filtration Plant. It is executed in full color on steel.**

● **ALL DETAILS of the preliminary color sketch held by the artist have been enlarged and transposed into the enamel medium of the sectional mural on the floor.**

Soils Classification,

THE BASIC approach to soil interpretation for the design of Michigan highways is the pedological method of mapping and classification of soils. This method is based on the visual examination of the weathered depth and the upper depth of the parent material of the soil profile. A continuous land surface area of like soil profiles is outlined by boundaries on a strip map of the highway right-of-way. The land area within a boundary is given a "name" soil classification for identification as established by the State Experiment Station of the U. S. Department of Agriculture.

The pedological system developed previously for agricultural purposes and used extensively in the preparation of the county soil maps has also become, by the addition of information and data pertaining to engineering properties, a classification for highway use. This approach to soil exploration is a rapid method to obtain basic soils information and to date has proven to be the most economical method in soil exploration practice.

The pedological soil map serves two functions: 1) Furnishes direct information to the Road and Bridge Design Divisions; and 2) indicates those locations where additional "point investigations" are required.

The first step in making a detailed soil map is a careful review of all available information. In Michigan, such information includes aerial photographs, the Michigan surface geology map, and the U. S. Department of Agriculture county soil maps. The study of aerial photographs in conjunction with a surface geology map gives the Soils Engineer an excellent background which can aid in the field identification of geological formations. The county soil map provides the Soils Engineer with a general idea of the soils that will be encountered and the position and description of each. In addition, he usually makes a preliminary study of road and railroad cuts and erosion soil exposures, of agricultural use and vegetation, of drainage patterns, and of mining operations, including clay and gravel pits.

After a review of this information, the Soils Engineer proceeds to the field to make the detailed soil map. The soil map may be made by one man, but usually two men are used as being faster and more efficient. The physical equipment needed consists of a soil legend, soil auger, tile spade and peat sampler. The field investigation consists of plotting all soil boundaries and noting on the map any special information such as locations of water table elevation, rock outcrops, suitable borrow material, and areas where further point investigation is required to determine such information as depth to clay and bedrock. The soil map may be prepared on cross section paper, plan and profile sheets or aerial photographs, but aerial photographs are preferred.

This article was prepared by the Michigan Highway Department in the Office of Testing and Research, W. W. McLaughlin, Testing and Research Engineer.

The pedological system uses geological surface features together with drainage and soil patterns as an aid to soil identification and classification but is founded primarily on the basis of the characteristics of the solum (weathered portion) of the soil in its natural state. The final soil classification and location of boundaries are determined by field examination of auger borings and all exposures, such as those in road and railroad cuts. Each excavation exposes a series of distinct soil layers or horizons which are called, collectively, the soil profile. The individual horizons and the parent material beneath are studied in detail, and the color, structure, porosity, consistency, texture, and organic content are noted. It is also necessary to observe the internal and external drainage, relief, vegetative cover, stoniness, agricultural utilization and geographical location. The soils are classified according to their characteristics, both internal and external, and are grouped on the basis of these characteristics into mapping units. With experience and training, the Soils Engineer can soon determine how many profile examinations are necessary to establish boundaries and classification. For a detailed description of pedological classification, the reader may wish to consult the "Soil Survey Manual, U. S. Department of Agriculture Handbook No. 18," issued August, 1951; and the "Field Manual of Soil Engineering (Third Edition)," published by the Michigan State Highway Department.

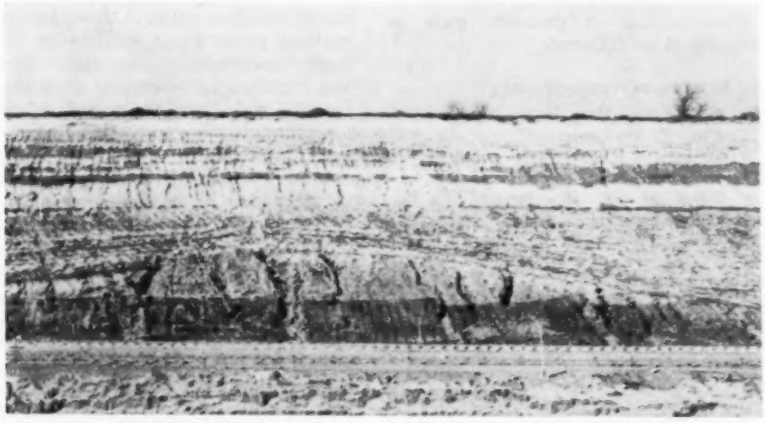
After the soil map has been completed with all additional information pertaining to rock outcrop, bedrock and water table soundings and locations where "point investigation" is required, it is submitted to design agencies for use in conjunction with the design charts. The design charts have been developed through years of experience and extensive research work by the Michigan State Highway Department. The final plan and profile sheet includes the soil map and additional soil information.

The pedological system of soil classification reduces expensive point investigation and soil sampling to a minimum. Special or point investigations include peat soundings, rock soundings, embankment and structure foundation borings, water table soundings, borrow pit investigations, earth resistivity surveys and samplings of soils for laboratory tests to determine specific physical properties. The areas where special investigations are needed are usually indicated on the soils map as it is being made in the field.

Peat Soundings

In swamp and alluvial areas, peat soundings are usually obtained by the engineering survey party assisted or supervised by the District Soils Engineer. In swamp areas that are of uniform depth and consist of a uniform class of material, the soundings are taken on cross sections at longer intervals (100 ft. maximum) than in the swamps having deep pockets and a wide variation in material. The spacing of soundings across the cross section varies with the type of roadway proposed. For a two lane facility, soundings are taken at the centerline and at a distance of 35 to 50 feet each side of centerline. For a divided highway, soundings are taken at centerline and at 50-ft.

distances up to 100 ft. each side of centerline. However, the relatively standard spacing of the soundings may be supplemented by soundings at closer intervals if the depth or character of the swamp changes rapidly. All potholes and small valleys are carefully examined to determine whether peat deposits have been buried by mineral soil materials washed in from higher levels. Michigan has many of these buried swamp deposits, and the inexperienced man may pass them over.



● **SOIL PROFILES through gravel and silt deposits are revealed by this cut on a state highway project Dark material is stacked sheets of wire mesh reinforcement.**

Shallow swamps (less than 3 or 4 ft. in depth) are usually sounded with a hand auger. Deeper deposits are sounded with a Davis peat sampler (¾-in. diameter piston type) with which relatively undisturbed samples may be obtained. When the soundings are being made, samples are taken at intervals of four feet vertically and at a change of stratum. Swamp materials are given comprehensive classifications as shown in the Michigan "Field Manual of Soil Engineering," based largely on the works of Dr. Alfred Dachnowski-Stokes. These are muck, woody peat, fibrous peat, sedimentary peat, marl and soft clay, and semi-organic sedimentary deposits.

In the case of an existing fill, borings are made through the existing fill with a continuous flight auger or wash borings. Quite often, soundings in alluvial materials and semi-organic sediments have to be supplemented by wash borings and undisturbed samples for laboratory tests.

Rock Soundings

The soil classifications that have underlying bedrock are listed for rock soundings. Types of rock soundings are divided into (1) preliminary soundings and (2) soundings to determine the profile and cross section of the bedrock surface. In both cases, the field notes should include not only the depth to rock, but also the characteristics of the overburden such as texture and depth to water table when it is a critical factor.

The preliminary rock soundings are indicated on the soils map. They are made usually by a 4 ft. hand auger, at intervals of one to three hundred feet along the centerline. After the preliminary grade has been established in areas which have been listed for rock soundings, soundings are then made at 100-ft. intervals to determine the presence of rock. When rock is encountered, soundings are taken on centerline and ditch locations on the right and left to determine the profile and cross section of the rock. Intermediate and additional soundings are taken where necessary. However, in level beds of sedimentary rock, fewer soundings are required.

The methods used for rock soundings are as follows: 1) Soil auger and post hole digger; 2) test pits; 3) wash borings; 4) power driven sounding rods; 5) continuous flight auger soundings; 6) resistivity surveys. Most rock soundings in accessible areas are made by a continuous flight auger supplemented by hand borings or mechanically driven sounding rods where necessary. This method has given excellent results with a minimum amount of time.

The field procedure is to drive the special steel rods, by means of the mechanical hammer, through the overburden to the bedrock or until the desired elevation is reached. The rod is then retrieved by use of the retriever clamp and hydraulic jacks.

When it is necessary to obtain supplemental information for this method, test pits may be dug, or soundings may be made with a soil auger and post hole digger. Wash borings have been successfully used for rock sounding work, but only to a limited extent.

The estimates of rock excavation made by these methods of soundings have been sufficiently accurate for highway construction. Primarily, they determine the thickness and characteristics of the unconsolidated material overlying the bedrock. When the grade is established in bedrock, it is not cored to ditch grade elevation. On occasion, when core borings in bedrock are necessary, they are made by a private firm under contract. The small amount of this work makes it uneconomical for the Department to maintain the necessary equipment.

Earth resistivity surveys have been used as a supplement to conventional rock soundings. Success, however, depends upon adequate correlation borings.

Foundation Borings

Foundation borings are made in Michigan for all bridges and culverts larger than 48-in. circular or its equivalent. The number and location of bridge borings are determined by the Design Office; 3 to 5 borings are obtained for grade separations. For structures over a river, one boring is obtained for each

foundation unit. For culverts, the number and location of borings are usually determined by the Engineer of Soils or by the District Soils Engineer. Culvert borings are usually made about 50 ft. apart along the length of the structure. In the case of borings for embankment foundation studies, the soils survey report indicates when investigation may be necessary. The number and location of borings are determined by the Engineer of Soils and the Design Office. Usually, one boring is made for each station involved. After construction of embankments in deep swamps, borings are made through the fill to determine the degree of peat displacement. This has a two-fold purpose: (1) to determine the stability of the fill and (2) to determine the pay quantities for the contract. The locations of these borings are determined by the Engineer of Soils. They are made at each station and at 3 to 6 points across the cross section.

The basic method used for determining foundation conditions is that of wash borings and undisturbed samples for laboratory tests. Borings with a continuous flight auger are used to a limited extent. However, we contemplate extending the use of this equipment.

The Department now has 5 boring crews, each crew consisting of one crew chief and three men. Each crew is equipped with a 2-ton truck and a ½-ton pick-up and the equipment listed below: One winch assembly with a 7 hp gasoline engine; one 8 to 10 hp two-cylinder gasoline engine with a piston type pump having a discharge capacity of 46 gpm of water at 225 psi pressure; one tripod with pulley attachment to facilitate lifting; 50 ft. of suction hose and approximately 600 ft. of 1-in. discharge hose; 100 ft. of 1-in. manila rope; 100 ft. of ¾-in. jet pipe in 4 ft. lengths; 100 ft. of 2-in. flush joint casing in 4-ft. lengths; six 8-ft. jet pipes with special tool steel chisel points; one working platform with casing head mounting; one level and level rod; and other miscellaneous tools such as driving hammer, special soil samplers, wrenches, peat samplers and augers.

There are two major methods of conducting wash boring foundation investigations. The first method is to wash the material up out of the ground and identify and obtain samples of the wash. The second method requires that the hole be washed to specified depths where undisturbed samples are obtained by various sampling tube devices. The wash method is fast and economical but requires special training to operate and log materials encountered. Valuable information is obtained from the "feel" in operating the equipment and the resistance of the soil to penetration. This ability is obtained by experience which requires that the personnel have a considerable amount of training (field and laboratory) before they are put in charge of a crew.

Granular materials may be penetrated to considerable depths and are classified as very loose, loose, moderately compact, compact, and very compact. Classification of granular materials made on the "feel" and penetration of the jet rods, occasionally supplemented by the number of blows per foot, is dependent upon the skill and experience of the boring crew chief. Classification in granular soils is obtained as follows:

Blow-Per Ft.	Classification
Below 4	Very loose
4 to 10	Loose
10 to 30	Moderately compact
30 to 50	Compact
Over 50	Very compact

Sampler: 2" O.D.
Hammer: 140 lbs., 30-in. drop

It should be recognized, however, that the use of standard penetration tests is not the final criterion in the classification of the material. As granular soils provide excellent foundation materials, the required depth of borings is seldom greater than 30 to 40 feet. The depth of the wash boring depends on the material encountered and the size of the structure.

The wash boring is started by washing a hole in the ground with an 8-ft. section of jet rod. A 12-ft. section of 2-in. O.D. casing is inserted into the hole and the working platform and casing head attached. The ¾-in. pipe is attached to the jet rod in 4-ft. lengths and placed inside the casing. Water is forced into the casing through the chisel point of the jet rod and the casing is rotated. The scouring action of the jet and casing shoe and the weight of the operator forces the casing downward. Where great resistance to penetration in gravel or very hard clay is encountered, the casing is driven by a special hammer. As the casing and jet rod proceed downward, the loosened material is washed to the surface where samples are collected, identified, and stored in glass jars for further testing or reference. An accurate log containing detailed information of the entire profile is maintained.

When cohesive materials are encountered, the same procedure is used, but the washing action is stopped at 5-ft. intervals and at any intermediate soil changes. The material is then sampled with special tube devices (split-spoon or internal liner sampling spoon) designed to secure relatively undisturbed samples. Undisturbed samples are taken for one of two purposes: 1) For visual inspection and logging purposes, then stored in airtight glass jars as save samples for future reference. 2) Transfer without disturbance to a special shipping container, sealed, and submitted to the laboratory for testing. The first method is a procedure used in preliminary investigations or where the loads imposed on the soil by the structure are small. The second method is primarly for use in cohesive soils where shear test values are required to determine accurately the soil bearing capacity and stability. Shear test samples are usually taken when the material is classified in the field as being very soft, soft or plastic in consistency. It is imperative that the boring crew chiefs are accurate in their classifications.

The consistency of the material is determined as follows: (a) very soft—completely lacking in resistance to external forces causing deformation; it will slump or deform of its own weight; (b) soft—slightly resistant to forces causing deformation; it can be molded readily without rupture and rolled to threads ⅛-in. or less in diameter; (c)—plastic—readily deformed without rupture; pliable, but cohesive, it can be molded and rolled to threads ⅛-in. in diameter without crumbling; (d) firm—moderately resistant to forces tending to produce rupture of deformation. Firm soil can be molded, but will likely crumble when rolled to threads ⅛-in. in diameter; (e) stiff—a soil which is resistant to forces causing deformation or rupture; it can be indented only slightly with the fingers; (f) hard—very resistant to forces causing deformation or rupture; the soil mass is dense and cannot be indented by the thumb and finger; (g) claypan—compact layers of soil which are high in clay content; it is not cemented and will flow together when wetted.

To assist in the standardization of information obtained from visual in-

spection, a consistency classification of clay soils as related to shearing resistance has been developed. This table is as follows:

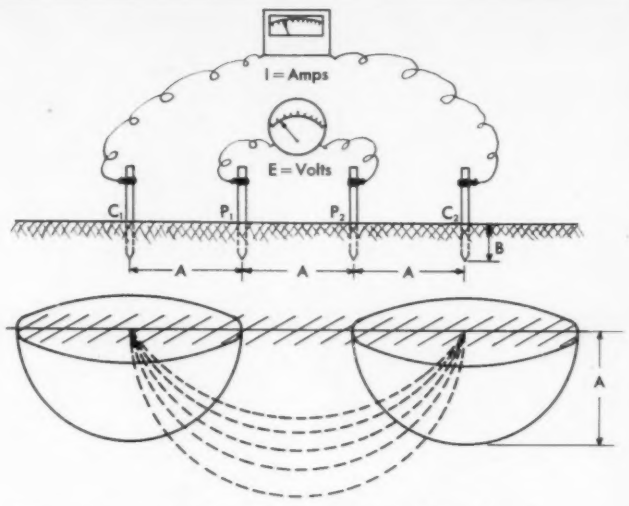
Soil Consistency	Shearing Resistance psi
Very soft	Less than 100
Soft	100-300
Plastic	250-500
Firm	400-800
Stiff	700-1200
Hard	1000-2000
Claypan	Greater than 2000

A copy of the shear test results are sent to the boring crew chief so that he may compare his field classification to the laboratory classification.

Although the general methods of wash borings are the same, very few boring projects are similar in all respects, and each project must be treated as a separate problem. It is for this reason that the men in charge of boring operations must be experienced in construction methods and have a certain amount of mechanical ingenuity. The senior boring crew chiefs are men with at least ten years of experience in the work.

All soil samples taken in connection with soil mapping and foundation borings are submitted to the Testing Laboratory for immediate or future testing by one of the two sections devoted to this work. The Soil Mechanics Section receives the undisturbed cohesive samples and, after careful preparation, conducts such tests as the transverse shear and the volumetric analysis. The results are compiled into a formal report and transmitted to the Bridge Division via the Engineer of Soils. The Soils Testing Section conducts all routine tests for determining the physical characteristics and behavior of soil. These tests include plasticity index, shrinkage limit, hydrometer analysis, permeability coefficient, capillary rise, specific gravity, maximum density, and special tests as required. The test results are reported through routine distribution channels to the Office of Design and Construction.

The Soil Exploration Section of the Testing Laboratory is devoted almost entirely to investigational work using the earth resistivity method of subsurface exploration and interpretation. This has been utilized by Michigan as a routine tool for subsurface exploration since 1951. Earth resistivity is a geophysical method of subsurface exploration based on the fact that different kinds of soil and rock exhibit different values of average apparent electrical resistivity. The Wenner[1] configuration is used, in which four electrodes are driven in the ground along a straight line and equidistant from each other. A known alternating electrical current is induced into the ground through the outside electrodes and the potential fall across the inner electrodes is measured. By inserting the measured values of amperage, voltage, and electrode spacing into Wenner's formula, the average apparent resistivity for any given soil mass can be obtained.



Wenner's equation for the average resistivity of soil:

$$\rho = \frac{4\pi AR}{1 + \frac{2A}{(A^2 + 4B^2)^{\frac{1}{2}}} - \frac{A}{(A^2 + B^2)^{\frac{1}{2}}}}$$

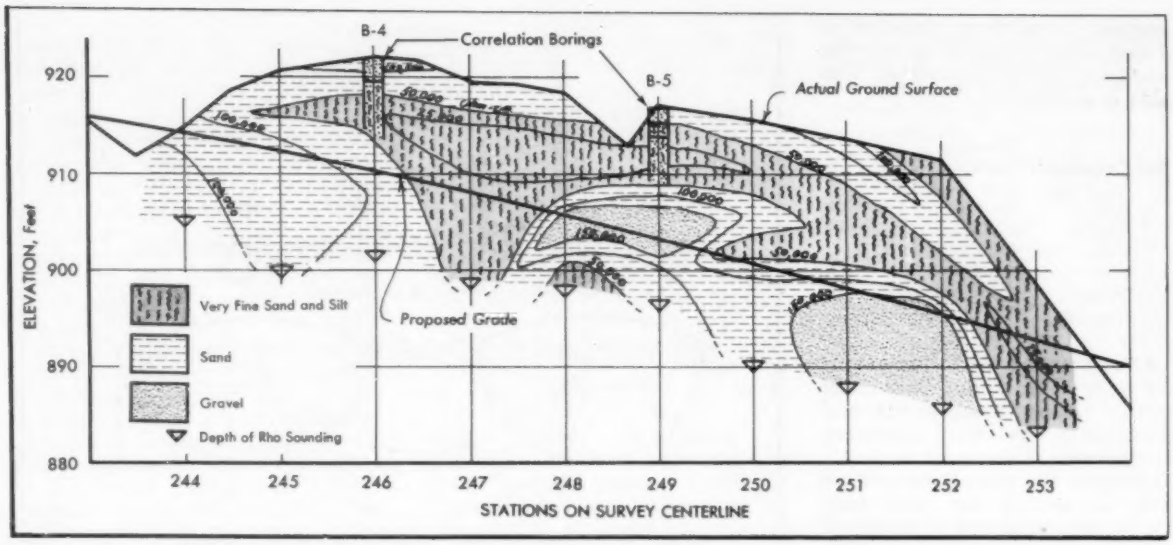
When B is small compared to A, the equation simplifies to:

$$\rho = 2\pi A \frac{E}{I}$$

A resistivity sounding consists of a series of incremented electrical measurements at electrode spacings. As the volume and depth of the measured soil mass is directly proportional to the electrode spacing, an electrical log from the ground surface to any depth is obtained.

The Department uses a slightly modified form of Wenner's formula in conjunction with the Barnes[2] Layer - Method of interpretation. With the layer-method it is possible to compute the apparent resistivity layer-value for each increment which reduces to a minimum the masking effects of the average apparent resistivity method which is conventionally used. The field data from each resistivity sounding, after being reduced, is plotted on a profile-contact chart in which apparent layer-values are plotted against depth. The depths of arbitrary layer-values are obtained graphically from the contact charts and plotted on a cross section as profile-contours. Inasmuch as different types of soil and rock generally fall into definable ranges of resistivity, the areas between certain profile-contours will outline different soil and rock types. The actual contact values for the different soil types are chosen by comparing the resistivity data with index correlation borings which are made for each survey. Correlation borings are made by a truck mounted continuous flight auger or a powered hand held continuous flight auger, or by hand borings, depending on terrain. The field data is presented in a formal report in the form of cross sections from profile-contours. These are pictorial graphs which represent the soil conditions as though one was looking at an exposed cut. Other pertinent data such as stationing, elevations, proposed grade, water table and index correlation boring logs are also shown.

Because the layer-method of interpretation used by Michigan is different than conventional methods, a special conductance instrument is



● **CROSS-SECTION from profile contours determined by a resistivity survey shows soil types, distribution and quantities.**

employed. This instrument was developed by collaboration of the Department and Associated Research Incorporated of Chicago. The result was the MICHIMHO Model 274M Vebroground, which is a light, mobile and rugged instrument designed for shallow depth surveys (under 100 ft. in depth), and which reads directly the average conductance between the inner electrodes.

In Michigan at the present time on major trunkline relocations, all cut sections greater than 12 feet in depth are surveyed by resistivity. The surveys are made subsequent to the establishment of horizontal and vertical alinement; consequently, the survey reports are not used as a basis for laying grades except where classified earth quantities become critical. However, the survey data are useful for other aspects of design.

Michigan soils, being the product of multiple glaciation, are extremely complicated. Rapid vertical and horizontal changes in soil texture are common; consequently, surface mapping of soil series does not always indicate soil conditions at grade. The subsurface information which resistivity surveys give is an aid in checking subbase and drainage design, completes the pictures of the soils in a cut and are utilized as materials inventories for the soil in deeper cut sections. The more granular soil fractions can be used for swamp fill, subbase, and porous backfill, while the heavier soils fulfill requirements for embankment construction. Survey reports are used by contractors to gain a knowledge of subsurface conditions which is reflected in lower bids.

Resistivity survey reports are useful to project engineers on construction as an aid during earthwork. For example, where a job ran from the fall into winter, the project engineer and the contractor set up a schedule whereby the clay cuts were excavated during dry weather and the granular cut sections were saved for wet and freezing weather. This enabled the job to run smoothly during all kinds of weather with practically no lost time.

District Soils Engineers use resistivity surveys as a tool for outlining different soil types in borrow pits. Small areas with relatively uniform soils are generally surveyed by hand or continuous flight auger borings while the larger areas are surveyed by resistivity.

A typical borrow pit survey consists of a series of parallel rho (resistivity) traverses which cover the area. A rho traverse is composed of a line of resistivity soundings which is plotted as a cross section from profile-contours. Individual resistivity soundings are maintained at 100-ft. intervals on rho traverse while the distance between rho traverses can vary between 100 to 200 ft., depending upon the uniformity of soil conditions.

After the cross sections from profile-contours have been plotted for a borrow pit, volumes of the different soil types are computed by the average end-area method and included in the report. The District Soils Engineer, therefore, knows the quantities of the different soil types and their physical distribution before the pit is opened up. This information is invaluable in purchasing the borrow and as a guide in setting up the method for pit excavation. Also, the engineer, knowing the borrow requirements for the job, has positive information as to additional kinds and volumes of borrow that need to be located.

The Department employs two resistivity field parties, a continuous flight auger boring rig for correlation borings, and an office staff to prepare reports. The resistivity field data for the larger jobs is reduced by electronic computers. A resistivity field party can make between 20 and 50 soundings per day, depending upon terrain and weather conditions.

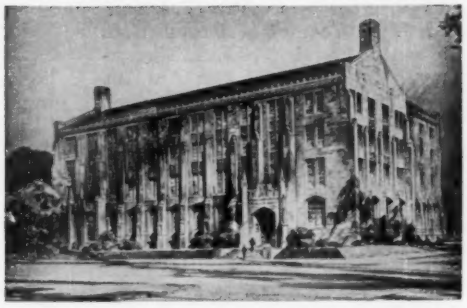
The Soils Engineering Section furnishes soil engineering services during all phases of survey, design, construction and maintenance. This includes special services such as the training of density control personnel, performing the operations of hydraulic fill consolidation, making check borings of swamp embankments and many special investigations related to soil and foundation problems.

References

1 Wenner, Frank, Method of Measuring Earth Resistivity: U. S. Bureau of Standards Scientific Paper No. 258, Vol. 12, No. 3, pp. 469-478, 1915-1916.

2 Barnes, H. E. Soil Investigation Employing a New Method of Layer-Value Determination for Earth Resistivity Interpretation: Highway Research Bulletin 65, pp. 25-36, 1952.

News BULLETINS



AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

New Manual On Transportation Planning is Now Available

Washington, D. C.—The first publication of the National Committee on Urban Transportation titled, "Better Transportation for Your City", is now available for general distribution. This manual is designed for use by legislative and administrative officials concerned with urban transportation problems. It presents in simple direct style how an effective transportation planning program can be organized, the specific studies to be carried out, and the sequence in which they should be undertaken.

A series of procedure manuals designed for use by technicians in carrying out the recommended studies has also been prepared and will be published in the near future. These manuals cover such surveys as origin-destination, traffic volumes, travel time, accidents, parking, inventory of street system, transit service, transportation administration, modernization of laws and ordinances and financial records and reports. Transportation standards are also provided so that the level of existing street and transit service can be measured after sufficient facts have been gathered and analyzed.

The new guide, together with its procedure manuals, will constitute the most complete and authoritative source material on transportation planning assembled to date. They were developed by nine subcommittees staffed with over 160 of the nation's foremost authorities in this field. The methods and procedures developed have been tested by seven pilot cities: Detroit, Phoenix, Syracuse, Albuquerque, Oak Park, Ill., Pocatello, Idaho, and San Diego, California.

The National Committee was organized in May, 1954, and is composed of representatives of the U. S. Bureau of Public Roads and eight national organizations of public officials. Ben West, Mayor of Nashville, Tennessee, who represents the American Municipal Association, recently assumed the Chairmanship of the Committee from Glenn Richards, Commissioner of Public Works of Detroit, who had been Chairman and APWA representative on the Committee since its inception.

The basic guide manual "Better Transportation for Your City" is priced at $4.00 per copy and may be obtained from: Public Administration Service, 1313 East 60th Street, Chicago 37, Illinois. The procedure manuals may also be purchased from this same source, in the near future, at nominal prices which have not, as yet, been announced.

Multi-City Drain Project Discussed At Michigan Chapter Meeting

Detroit, Mich.—The last meeting of the Michigan Chapter was held at Huck's Redford Inn on Wednesday, November 20, with President Joe Jewell, Superintendent of Public Works of Pontiac, presiding.

A. J. Berst, Coordinator of the "Twelve Town Drain" project for the Oakland County Drain Commission, was the guest speaker. This is a storm water relief project planned for an urban area of approximately 37 square miles, including twelve originally, but now fourteen municipal units within the Detroit Metropolitan region.

It was pointed out that the project involves the installation of approximately 38 miles of drains, ten of which will require tunnel work. The project is designed to supplement a system of county storm drains constructed in the 1920's. Inadequacy of the existing network of drains was brought about by the tremendous real estate development in the area which, for the most part, has occurred since 1950.

Mr. Berst explained that the cities in the area realized the need for a cooperative solution to their individual drainage problems several years ago and began working with the County Drain Commissioner, Ralph A. Mann, on the development of a joint project. It is estimated to cost about thirty million dollars.

Randall Elected President Of Southern California Chapter

Los Angeles, Calif.—One of the highlights of the November meeting of the Southern California Chapter was the election of officers for the coming year. The top post went to Frank E. Randall, Right-of-Way Superintendent of the Pacific Telephone and Telegraph Company, who has been one of the chapter's strongest supporters for many years. He succeeds Ben R. Paris, Director of Street Maintenance for the City of Los Angeles. John A. Lambie, County Engineer for Los Angeles County,

OFFICERS: Sol Ellenson, Newport News, Va., *President;* Wm. D. Hurst, Winnipeg, Manitoba, Canada, *Vice President.* REGIONAL DIRECTORS: (term ending 1958) Jean L. Vincenz, San Diego, Calif.; Leo Flotron, Dayton, Ohio; Roy W. McLeese, Salt Lake City, Utah; (term ending 1959) Albert G. Wyler, New Orleans, La.; Edward J. Booth, Bismarck, N. D.; Frederick Crane, Buffalo, N. Y.; (term ending 1960) Charles W. Cooke, Hartford, Conn.; R. S. Hopson, Richmond, Va.; H. H. Hester, Fort Worth, Texas. *Immediate Past President,* Robert Anderson, Winnetka, Ill. Donald F. Herrick, *Executive Director*

was elected First Vice President and J. A. Thompson, President of the contracting firm of J. A. Thompson and Son, Inc. of Los Angeles, was named Second Vice President. C. C. Westmoreland, Supervising Engineer of the Southern California Gas Company, was re-elected Secretary-Treasurer.

The afternoon program included a talk on "The Merits of Contract Procedure on Public Works Projects" by R. V. Edwards, President, American Pipe and Construction Company, and another on "Equipment for Public Works" by Allan S. McClimon, Manager, Sales Development, Euclid Division, General Motors Corporation, Cleveland, Ohio. It was pointed out that—"Equipment and tools make men productive. If labor on the job is idle, the time paid for is a total loss. If equipment is idle, there is no charge and you retain the equipment. To balance the equation, labor versus equipment requires a common denominator—wages for equipment the same as wages for workers. Wages for equipment is the sum of interest on the purchase price, plus depreciation, maintenance and operating charges, less a resale value credit."

The dinner meeting featured a penetrating talk on "Urban Development in Southern California" by the Honorable Fletcher Bowron, Judge of the Superior Court, who is former Mayor of the City of Los Angeles and Past President of the American Municipal Association and the League of California Cities.

Indiana Public Works Officials Form State Chapter of APWA

Fort Wayne, Ind.—Nearly seventy Public Works engineers and administrators from all parts of the State gathered at the Van Orman Northcrest Highway Hotel in Fort Wayne on Wednesday, November 6, to form the 28th Chapter of the American Public Works Association.

B. J. Swanson, Chairman of the Board of Public Works, was in charge of the meeting which began at noon with a Reception and Kick-Off Luncheon. Mayor Robert E. Meyers welcomed the delegates to the city and Robert L. Anderson, Immediate Past-President of the National Organization and Village Engineer of Winnetka, Illinois, was the guest speaker.

The afternoon portion of the program featured a "Public Works Problem Clinic" moderated by Mayor W. D. Jefferson of Rochester, Ind. Participants on the panel included: Herman Pope, Executive Director, Public Administration Service of Chicago; Don Bloodgood, Professor of Sanitary Engineering, Purdue University; Dan Richardson, Street Commissioner, South Bend, Ind.; Leo Weaver, Sanitary Engineer, U. S. Public Health Service and Secretary of the APWA Refuse Collection and Disposal Committees; Jan Schmedding, Consultant, Michigan Asphalt Paving Association and former Superintendent of Street Construction and Maintenance for Detroit, Michigan; and Robert Heider, Director, Sanitary Engineering Division, State Board of Health, Indianapolis, Indiana. The Clinic was followed by an excellent talk on "Homemade Government for Homefolks" by Charles Hyneman, Professor of Political Science, Indiana University, Bloomington, Indiana.

One of the highlights of the meeting was the presentation of a Certificate of Appreciation to the City of Fort Wayne for faithfully supporting the work of the Association by maintaining a "Public Agency" membership in the APWA for ten consecutive years. Mr. Anderson, in presenting the certificate to Mayor Meyers, said that it was

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fitting that his city receive this special recognition since it was well represented at the first national meeting of public works officials in Buffalo, New York, in 1894. (The organization established at that time was known as the American Society for Municipal Improvements which merged with the International Association of Public Works Officials in 1937 to form the American Public Works Association.)

The chapter's first slate of officers was nominated by a Committee consisting of: Jan Ludwig, Street Commissioner, Lafayette, Ind., Chairman; John Cooper, Member, Board of Public Works, Fort Wayne; and Robert Long, President, Board of Public Works, Elkhart. The officers nominated and elected were: B. J. Swanson, Chairman, Board of Public Works, Fort Wayne, President; Dan Richardson, Street Commissioner, South Bend, Vice President, and Donald Gwinnup, City Engineer, Anderson, Secretary-Treasurer. Others elected to serve on the Executive Committee were: Don Bloodgood, Professor of Sanitary Engineering, Purdue University, W. Lafayette; W. D. Jefferson, Mayor, Rochester; Robert Heider, Director, Division of Sanitary Engineering, State Board of Health, Indianapolis; and Ralph Lentz, Street Commissioner, Plymouth.

Northern California Chapter Holds Annual Meeting in Berkeley

Berkeley, Calif.—The Northern California Chapter of the American Public Works Association held its fifth Annual Meeting on Friday, November 15th at the Claremont Hotel, Berkeley. The program included a luncheon attended by more than 125 members and guests, an afternoon discussion panel, a hospitality hour, dinner and dancing.

The main address at the luncheon was given by Professor T. Y. Lin, University of California Professor of Structural Engineering, who spoke on "Highlights and Interesting Personalities at the Recent World Conference on Prestressed Concrete".

Past President Emil J. Kaleschke acted as Moderator for the panel discussion on "Modern Methods and Equipment". Among those participating in the afternoon panel discussion were Mel Wright, District Sales Manager, Ingersoll Kalamazoo Division, Borg Warner Corporation, who spoke on refuse collection and disposal equipment;

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James I. Ballard, Editorial Director, "Western Construction", and Talbot D. Bailey, Vice-President, Fredrickson and Watson Construction Company, who spoke on street construction and maintenance; and Thomas K. McManus, Vice-President, Underground Construction Company, who discussed sub-surface construction and maintenance.

Following the panel discussion, the afternoon session featured an address by William L. Berry, Chief of Division of Resources Planning, State of California, Department of Water Resources, whose subject was "Latest Development in the California Water Plan".

Lee J. Rothgery, Engineer, Institute of Transportation and Traffic Engineering, University of California, was Program Chairman. Olof E. Anderson, Chapter President and County Surveyor and Road Commissioner for Alameda County, presided at the meeting.

Taylor Elected President of San Diego-Imperial Chapter

San Diego, Calif.—The San Diego-Imperial County Chapter held a luncheon meeting at the Lafayette Hotel in San Diego, with a program featuring a film and an informative talk on asphaltic seal coats by Ed Morgan of the American Bitumuls and Asphalt Company.

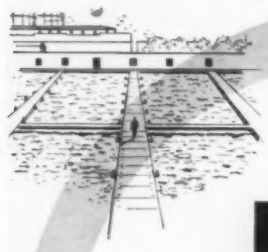
Chapter President John W. Davis, Assistant Commissioner of the San Diego County Road Department, announced that Richard Gallager, Director of Public Works of the City of San Diego, had been appointed General Chairman of a Committee to make arrangements for the Western Public Works Conference to be held in San Diego in June, 1958.

Another highlight of the meeting was the election of officers for 1957-1958 term. Ernest A. Taylor, Street Superintendent of Oceanside, was elected President; Warren A. Barney, Chief Engineer, San Diego County, Department of Public Works, became 1st Vice President; and Norman Beenfeldt, Division Engineer, California Water and Telephone Co., Chula Vista, was installed as 2nd Vice President. The Secretary-Treasurer's post went to Robert Hoke, Sales Engineer, American Bitumuls and Asphalt Co. of San Diego.

Others elected to serve on the Executive Committee were: V. A. Parker, Assistant Director of Public Works, City of San Diego; E. F. Gabrielson, Principal Civil Engineer, City of San Diego; H. C. Dennis, Vice President, V. R. Dennis Construction Co., San Diego; W. H. Miller, Director of Planning, County of San Diego; and C. R. Crull, Municipal Engineering Consultant of San Diego.

Minister Of Industry And Commerce Speaks At Manitoba Meeting

Winnipeg, Man.—The Fall meeting of the Manitoba Chapter of the American Public Works Association was held in the Marlborough Hotel on Friday, October 25. The guest speaker for the evening meeting was the Honorable F. L. Jobin, Provincial Minister of Industry of Commerce, who said: "If there is any slackening in Winnipeg's growth it will be due to a sort of bad housekeeping—a lack of adequate living quarters for workers, neglected local transportation, haphazard local government and an apathy toward public improvements." Apart from these dangers, Mr. Jobin painted a glowing picture of Greater Winnipeg's future and predicted a steadily controlled growth on a sound financial basis and a population of 650,000 by 1980.



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The chapter membership warmly congratulated City Engineer William D. Hurst on being elected Vice-President of the APWA. A new slate of chapter officers was also installed: Robert Strain, Engineer for the Manitoba Telephone System, was elected to succeed M. L. Jeroff, Municipal Engineer of West Kildonan, as President of the chapter. The Vice-President's post went to John Baker, Superintendent of Construction for the City of Winnipeg, and C. A. Keeping, Engineer of Streets, was re-elected Secretary-Treasurer. Others elected to the Executive Committee were: H. Akehurst, City Engineer, Brandon; A. B. Moffatt, Superintendent of Public Works, Selkirk; I. Simkin, President of Simkin's Construction, Limited; and E. G. Simpson, Engineer of Inspections for the City of Winnipeg.

• • •

Refuse Collection Data From Akron

F. L. WOODCOCK,
Supt., Waste Collection & Disposal

The City of Akron, Ohio, uses 18 packer type trucks of 15-cu. yd. capacity. These trucks are for garbage collection only. At the time of their purchase, the 15-cu. yd. body was considered to be the most economical, but our more recent experience shows that the 20-cu. yd. body is more practical.

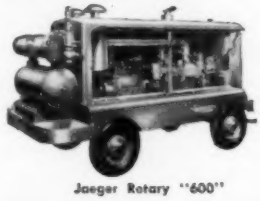
There are 3-man crews on each unit, a driver and two collectors. They collect from the rear of residences and business establishments. There are approximately 600 pick-ups per unit per day and an average weight load is 10,000 lbs. The length of the routes vary, due to the population. Some areas are well developed while others are widely scattered. The average haul to the disposal site is 5 miles.

All trucks are steam cleaned on the inside at the finish of the day's work. They are cleaned on the exterior once a week. This cleaning keeps the trucks odor-free except in rare cases when we have had to use a disinfectant solution.

In April of this year, our collection system was revised, reducing our routes from 25 to 18. This revision eliminated all open bed trucks. The capacity of the packer type truck is sufficient to carry one day's collection. This results in a savings in travel time to and from disposal sites by open bed trucks. Due to this change, it is difficult to make an estimate in savings at this time.

Trenching 7 miles of street, this Jaeger "125" Roto ran two 80 lb. breakers to line-cut and break a 7" top of asphalt over brick — averaged 1200 sq. ft. per 8 hr. day—used only 1½ gals. of fuel per hr.

Jaeger "125" Rotary speeds street work



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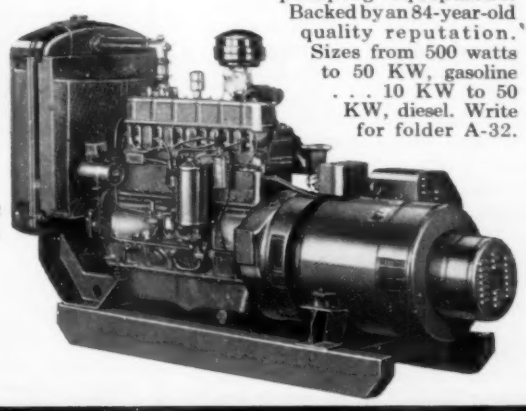

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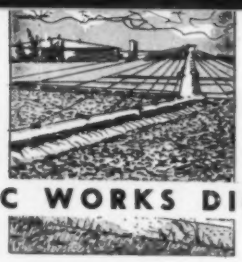


PUBLIC WORKS DIGESTS

Prepared by
ALVIN R. JACOBSON, Ph.D.
Associate Professor and Head,
Division of Sanitary Science,
Columbia University School of Public Health

THE SEWERAGE AND REFUSE DIGEST

L. A. Enlarges Sewage Facilities

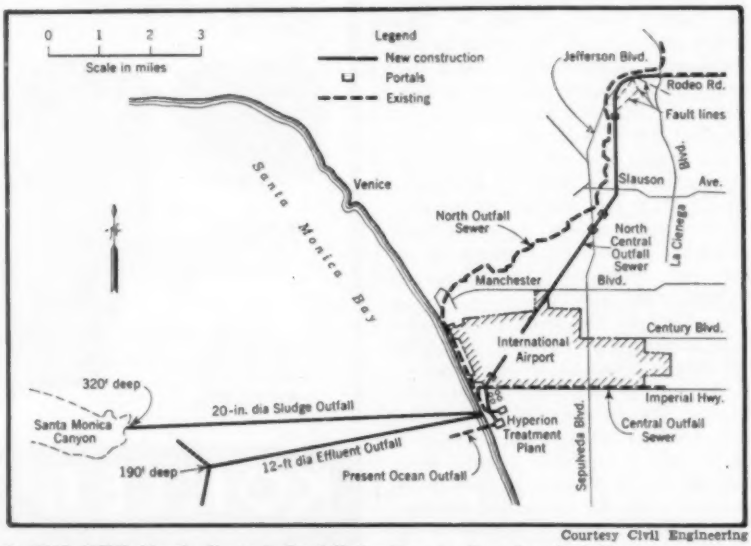
Los Angeles has had to increase its sewage treatment facilities due to a phenomenal population growth. The present site at Hyperion, in use since 1894, consists of two major land outfalls conducting sewage to the Hyperion Treatment Plant. This plant utilizes a high-rate activated sludge process at an average flow capacity of 245 mgd and consists of mechanically cleaned bar screen detritors, primary sedimentation tanks, aeration tanks, final settling tanks and an ocean outfall extending about 1 mile out into Santa Monica Bay. In addition the sludge from the digestion tanks is filtered, dried and converted into fertilizer. The final effluent is chlorinated before being discharged into Santa Monica Bay at an annual cost of about $200,000. All electricity and power for producing compressed air is produced by generators driven by dual-fuel diesel engines operating principally on the gases obtained as a by-product from the sludge digestion process. The two principal costs in the present scheme of operation are for the heavy chlorination that is required and in the production of the fertilizer. In 1954, a Citizens Committee after several months of study recommended the following facilities to meet present demands: A new land outfall; modifications and enlargements to the existing treatment facilities; an ocean outfall and pumping plant to discharge effluent five miles offshore; an ocean outfall and pumping plant to discharge digested sludge seven miles offshore; and major additions to the existing-lateral collecting system. The two major land outfalls currently serving the city of Los Angeles as well as the new North Central sewer are shown in the accompanying illustration. This new sewer is 9½ ft. in diameter and 42,000 ft. in length. All of the above improvements are being made to increase the capacity of the Los Angeles sewerage system from an average flow of 245 to 420 mgd at a cost of about $60,000,000.

"Long Land Outfall Built Through Baldwin Hills." By David L. Narver and E. H. Graham. *Civil Engineering*, December, 1957. (See also PUBLIC WORKS, Feb. 1957, pages 93-96.)

Sewage Solids Incineration

This article makes a comprehensive examination of all sewage solids incineration costs. In making these cost examinations it is recognized that it is necessary to study the sewage plant as a whole; that is, its separate components, what each will accomplish and what each operation will cost. To rationalize performance and cost data a comparison of sewage treatment plant costs and accomplishments for four different cities was made, namely: Buffalo, N. Y.; Cleveland, Ohio; Detroit, Mich.; and Minneapolis-St. Paul, Minn. Other factors that are taken into account in calculating incineration costs are the manner of operation of an incinerator which is, in turn, affected by operator training, initiative, and the availability of an up-to-date set of operating instructions. Modern measurement and control equipment are also instrumental in obtaining maximum system capacity which brings about minimum investment costs as well as minimum maintenance. The characteristics of sewage solids normally lack uniformity, this having a definite bearing on incineration costs. Moisture content affects the rate of combustion which must be compensated for in the daily operating procedures. A comprehensive examination of sewage solids incineration costs can serve to determine whether or not incineration is the most efficient method of sewage solids disposal for a particular sewage treatment plant objective. It can also aid in the determination of which of the available incineration systems is the most economical to operate. It can also form a basis for comparing similar systems to aid in setting guides and limits to maintenance, attendance and other service factors in order to obtain maximum capacity and efficiency.

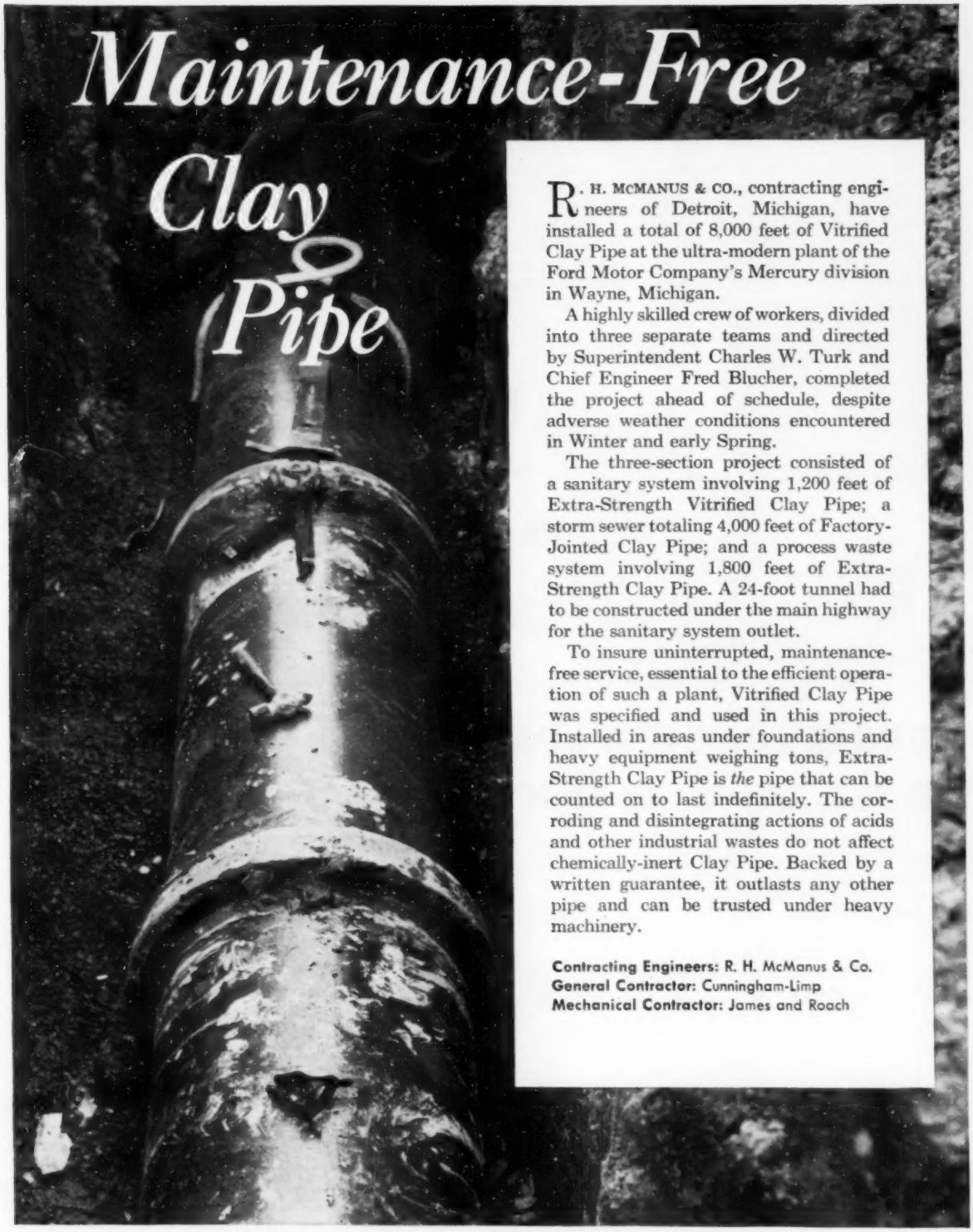
"An Examination of Sewage Solids Incineration Costs." By Kerwin L.



Courtesy Civil Engineering

● **THE NEW North Central Outfall leading to Los Angeles' Hyperion sewage treatment plant is 42,000 feet long; capacity is 354 mgd when three-fourths full.**

Maintenance-Free Clay Pipe



R. H. McMANUS & CO., contracting engineers of Detroit, Michigan, have installed a total of 8,000 feet of Vitrified Clay Pipe at the ultra-modern plant of the Ford Motor Company's Mercury division in Wayne, Michigan.

A highly skilled crew of workers, divided into three separate teams and directed by Superintendent Charles W. Turk and Chief Engineer Fred Blucher, completed the project ahead of schedule, despite adverse weather conditions encountered in Winter and early Spring.

The three-section project consisted of a sanitary system involving 1,200 feet of Extra-Strength Vitrified Clay Pipe; a storm sewer totaling 4,000 feet of Factory-Jointed Clay Pipe; and a process waste system involving 1,800 feet of Extra-Strength Clay Pipe. A 24-foot tunnel had to be constructed under the main highway for the sanitary system outlet.

To insure uninterrupted, maintenance-free service, essential to the efficient operation of such a plant, Vitrified Clay Pipe was specified and used in this project. Installed in areas under foundations and heavy equipment weighing tons, Extra-Strength Clay Pipe is *the* pipe that can be counted on to last indefinitely. The corroding and disintegrating actions of acids and other industrial wastes do not affect chemically-inert Clay Pipe. Backed by a written guarantee, it outlasts any other pipe and can be trusted under heavy machinery.

Contracting Engineers: R. H. McManus & Co.
General Contractor: Cunningham-Limp
Mechanical Contractor: James and Roach

C-158-3

Vitrified **CLAY PIPE** *Never Wears Out*

NATIONAL CLAY PIPE MANUFACTURERS, INC. 1520 18th St. N. W., Washington 6, D. C.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio • 703 Ninth & Hill Bldg., Los Angeles 15, Calif. • 100 N. La Salle St., Rm. 2100, Chicago 2, Ill. • 206 Mark Bldg., Atlanta 3, Ga.

Mick and Scott E. Linsley. *Water and Sewage Works*, November, 1957.

Louisville's New Incinerator

Louisville's new, modern incinerator has been designed so that it will handle mixed refuse, heavy timbers with nails, and trees up to 30-in. diameter; and it has facilities for drying sewage sludge from the new sewage treatment plant when this is completed. The incinerator units are charged by means of two 5-ton cranes with a uniform mixture of refuse to maintain even temperatures. Three of the four proposed 250-ton day units are being installed at present; these will provide continuous feed, continuous advance and tumbling of refuse with continuous discharge of residue. Each unit uses reciprocating type drying and ignition grates, a rotary kiln and a combustion chamber. The incoming refuse is partially dried by the heat from the combustion of the refuse in the ignition chamber. Normally about 50% of the combustion takes place in the ignition chamber where the actual burning cycle begins. All controls for each incinerator unit are grouped on a control panel so that one man can operate two incineration units. Gases from the combustion chambers are drawn through spray collectors to collect the flyash by impact on the wet surface of the baffles. The sewage sludge from the vacuum filters of the new sewage treatment plant will be dried by flash drying equipment and sold as a fertilizer filler or as a fertilizer. Any excess sludge will be discharged by means of a pneumatic conveyor to either of two incinerator units for burning. The residue or fine black ash is used as fill after tin cans and scrap are separated mechanically. The cans and scrap are pressed into bales 14 in. x 14 in. x 20 in. weighing about 400 pounds and are then sold as scrap.

"Operating Louisville's New Incinerator." By Henry J. Cates. PUBLIC WORKS, December, 1957.

ENGINEERING BALLOT BOX

We like to think of M & H valves and hydrants as "candidates" in an election contest. The "voters" are the engineers and water works men of the United States. The "ballots" are material specifications and purchase orders. As this "election" stands today, M & H products rank high among the winners.

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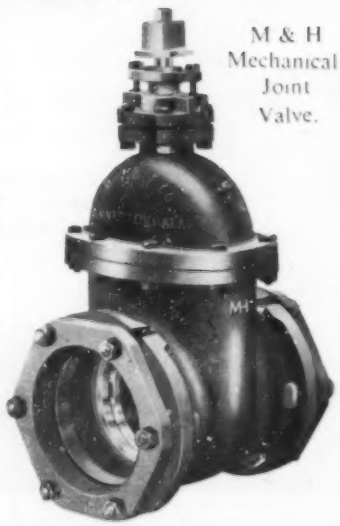

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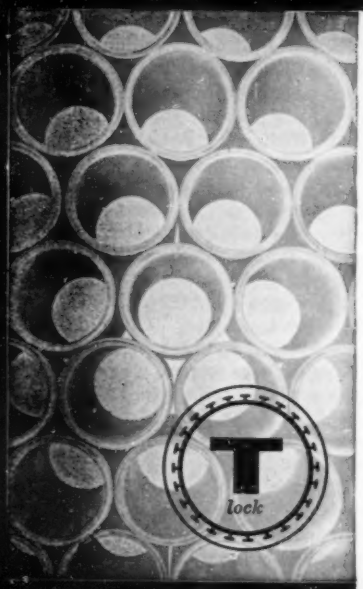
Enzymes Correct Digester Troubles

Since January, 1955, all garbage in Genoa, Ill., has been trucked to the sewage treatment plant, ground and fed in the form of a slurry to the sludge digestion tank. The treatment plant serving a population of about 2,500 persons, consists of a bar screen, primary sedimentation, trickling filter, one heated digester and a sand sludge drying bed. During 1955 the digester operated satisfactorily, however, a scum layer was gradually forming, but the digested sludge dried quite satisfactorily. The scum layer continued increasing in thickness and drying qualities of the sludge decreased, Gas production also decreased necessitating the use of an increased amount of oil for heating the sludge digesters. The digested sludge applied to the drying beds had a sour odor, attracted flies and had poor drying qualities. The scum layer had increased in thickness up to about 3½ ft. in December, 1956, and sludge digestion had almost come to a standstill. A decision was made to try the addition of enzymes and 1 pound of 'Sea-Cal' Formula-200 was added to the digester each day for 10 days, then the amount was reduced to 1 pound weekly for 5 weeks and finally the dosage was adjusted to 2 pounds per week for the next 14 weeks. Gas production increased markedly, cutting down the amount of oil used weekly from an average 100 gallons per week before addition of enzymes to 45 gallons per week thereafter. The sludge softened and liquefied and when applied to the drying beds dried very satisfactorily. At a cost of $8 per pound the total expenditure for enzymes from December 21,



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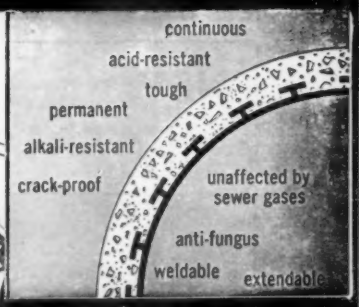

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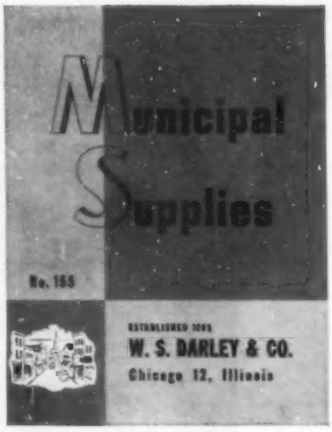

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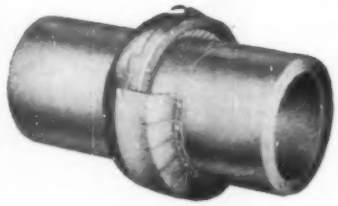

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1956 to March 23, 1957 amounted to $232 which the authors believed to be negligible compared to the cost of cleaning the digester. In addition, the savings in cost of oil for heating the digesters almost paid the cost of the enzyme preparation used. The authors also observed that addition of enzymes to the wet well feeding the trickling filters removed all grease and scum from the distributor nozzles which had caused them to clog.

"Enzymes Correct Digester Troubles and Eliminate Grease Problems." By Paul R. Carlson and Perry Cornell. *Water and Sewage Works*, November, 1957.

Other Articles

"**Toxicity Investigations** on Aquatic and Marine Life." By Jack T. Garrett. Public Works, December, 1957.

"**Compressed Air** Applications in Sewage and Water Works." By J. L. Hylton. Water and Sewage Works, November, 1957.

"Public Health Service **Research Grants Program**." By Harry A. Faber. Public Works, December, 1957.

"From Ohio River Surveys to a Clinic for **Sanitary Engineering Problems**." Public Works, December, 1957.

"High Rate **Composting** May Solve Refuse Disposal Problems." By Donald Brenner. Public Works, December, 1957.

"**Detergent Break-Down** and Air Pollution by Inefficient Combustion." By P. H. McGauhey. Public Works, December, 1957.

"The Survival of **Pathogenic Organisms in Sewage**." By Stuart G. Dunlop. Public Works, December, 1957.

"New Concepts of **Sedimentation**." By William E. Budd. Public Works, December, 1957.

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Refuse Collection by Packer-Type Vehicles

(*Continued from page* 107)

four open truck loads. Norfolk, Va., C. W. Armstrong, Street Sanitation Sup't., estimates the daily saving at $25 per unit. Milwaukee, Wisc., W. J. Rheinfrink, Sup't. of Street Sanitation, places the saving at 50 percent.

Cleaning and Chemical Treatment for Collection Vehicles

Relatively few cities feel the need for special precautions to prevent odors emanating from refuse collection vehicles or for the need for insecticides. Birmingham, Ala., Neal McRae, Sup't. of Streets and Sanitation, washes the trucks only. Little Rock uses steam and hot water. Sacramento, Calif., Jack E. Cronan, Sup't. of Waste Removal, cleans with steam. Hartford, Conn., uses a steam jenny and daily hosing. Waterbury employs daily hosing and also uses an insecticide. Denver, Colo., H. O. Patton, Sup't., Sanitary Service, uses steam cleaning occasionally. Jacksonville, Fla., R. E. Parrish, Sup't., Street Cleaning Dep't., uses steam and high pressure hose. Atlanta uses steam cleaning and also a deodorant. Savannah, Ga., W. L. Wilson, Actg. Dir. of Public Improvements, washes down with a pressure hose.

Boston, Mass., P. J. Leary, Sanitary Division, Public Works Dep't., washes trucks with a hose but uses no chemicals. Lynn, Mass., washes and steams. Worcester, Mass., uses a high pressure water hose and treats with both odor masking chemicals and insecticides. Detroit, Mich., R. E. Schink, Ass't. Sup't., Division of Sanitation, cleans by water under pressure once or twice daily but does not use chemicals. Flint, Mich., cleans occasionally with cold water. Kansas City, Mo., Clarendon Rea, Comm'r. of Refuse Collection, washes daily and steams weekly. St. Louis, Mo., E. W. Deering, Commissioner, washes trucks and uses a deodorant on garbage trucks. Omaha, Nebr., flushes and steams for cleaning.

Newark, N. J., T. B. Struble, General Sup't., Div. of Sanitation, hoses trucks at the end of the working day. New York City washes with water hose. Rochester, N. Y., J. Emmett Sheehan, Sup't of Refuse Collection, cleans with steam. Toledo, O., H. M. Loucke, Comm'r. of Streets, uses a hot water hose and a deodorant and insecticide. Youngstown, O., uses a steam jenny. Philadelphia cleans by overhead washing racks, using a washing solution. Providence, R. I., Howard F. Carpenter, Chief, uses a steam wash and an insecticide. Austin, Tex., W. N. Osburn, Gen. Supt., uses bulk soap, water and steam cleaning. Dallas, Tex., G. C. Brinkley, Garbage & Street Cleaning Supervisor, washes the trucks. Houston, Texas, uses a portable steam cleaner with cleaning compound. Memphis, Tenn., W. H. Hugo, Sup't of Refuse and Streets, uses steam and hot water and a coal tar disinfectant. Salt Lake City, Utah, washes and steams. Norfolk, Va., uses steam cleaning. Seattle, Wash., H. J. Mashinter, Supr. of Sanitary Operations, steam cleans. Milwaukee, Wisc. uses a hose and broom.

Personnel and Routes

Some of the cities reported crew sizes, as follows: Birmingham, Ala., 4; Little Rock, Ark., 3 and 4; Sacramento, Calif., 3; Hartford, Conn., driver and 5 men; Waterbury, Conn., 4; Denver, Colo., driver and 2 men; Jacksonville, Fla., driver and 2 men; Atlanta, Ga., 3 and 4; Savannah, Ga., driver and 3; Boston, Mass., driver and 2; Lynn, Mass., 3; Somerville, Mass., 3; Worcester, Mass., 3 or 4; Detroit, Mich., driver and 2; Flint, Mich., 2; Kansas City, Mo., 3; St. Louis, Mo., driver and 2; Omaha, Nebr., 3; Newark, N. J., 3; New York, N. Y., 3; Rochester, N. Y., 8; Toledo, O., driver and 3; Youngstown, O., 3; Philadelphia, Pa., driver and 2; Providence, R. I., driver and 2; Austin, Tex., driver and 2; Dallas, Tex., 3; Houston, Tex., driver and 2; Memphis, Tenn., 5; Salt Lake City, Utah, 2; Norfolk, Va., driver and 2; Seattle, Wash., 2; and Milwaukee, Wisc., 3 to 5.

No reliable data could be obtained on average length of collection route or on average length of haul to disposal area. These are, of course, dependent on local conditions and may be different for each route. Also, the size of the city will often be a determining factor.

Refuse Collection Practice in Tacoma

C. M. HIBERLY,
Supervisor, Refuse Collection

The City of Tacoma, Wash., operates 20 packer type bodies, 18 having a capacity of 12 cubic yards and 2 having a capacity of 15 cubic yards. The weight of the refuse load averages 3 to 3½ tons in the 12-yard and 4 to 4½ tons in the 15-yard bodies.

The size of units most advantageous for general use would ordinarily be determined by the type of alleys and roadways in which the equipment must be used. In our own case, in almost all instances, the larger the capacity the more advantageous for general use. Because the department will soon be faced with considerably longer hauls on account of a proposed change in the disposal area location we are in the process of purchasing four 20-yard bodies. This size was not available at the time of our last previous purchases.

Our crews average from 500 to 600 garbage cans picked up per day. Collections are made from any place on the property as required or requested by the customer. (Note: Rates charged for collection service are graduated to cover any type of service required). On the packer type units 3 men are employed (one driver and two helpers).

We have no accurate data as to the average length of collection routes. However, the mileage compiled per unit per day is between 35 and 45 miles. The average length of haul to the present disposal area is approximately 2½ miles.

Our procedure for cleaning trucks is poor because of lack of cleaning equipment. At present we simply wash with a cold water hose. We have not improved our cleaning facilities as we expect to erect a new garage soon. It is our intention as soon as our proposed garage is established to install suitable wash racks and steam cleaning equipment.

We do not use any chemicals to mask odors at this time. We have just ordered, however, on a trial basis, chemicals for this purpose. We have not treated our trucks with insecticides. Up to the present time we have noted no necessity for such treatment.

It is impossible for us to give an immediate estimate of savings due to packer type equipment. However, it should be noted that by the installation of this type of body we are able to service an increase in

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customer accounts of some 6000 additional residential and business services during the last 5 years without increasing the number of routes or the number of truck units.

We have just placed orders, but have not yet received delivery, for four trucks and four bodies. For the reasons noted above we have increased body capacity to 20 cubic yards. We feel that in most instances we will be able to complete daily route pickups in 2 loads rather than 3 as at present. We feel that the time saved in this manner will tend to offset the additional time requirements occasioned by longer hauls. In going up to a 20-yard body we became aware that we were approaching the maximum statutory limitation of 18,000 pounds on the rear axle. In order to get proper weight distribution without going into tandem rear axles we have ordered Cab-over type chassis. This not only shortens the wheel base and the turning radius but throws the center of gravity forward toward the front axle, adding to the safety factor of load dumping without tipping. In order to carry the additional weight forward we have specified an 11,000-pound front axle. Because the extra forward weight will make steering quite a heavier job we have specified power-steering. For the rear axle we specified a 22,000-pound double reduction rear end. This is heavier than necessary for the weights involved. We use this weight and the double reduction type to offset the strains at that point occasioned by constant stopping and starting under full loads. Since adopting this type of rear axle we have been almost entirely free from rear axle breakages. We have also specified 14-inch clutch, together with a 6-cylinder engine, heavier springs and brakes to carry a 9500-pound body and 11,000 pounds pay load.

Refuse Operations in Pasadena

DOUGLAS C. MacKENZIE,
City Engineer-Supt. of Streets

The City of Pasadena, Calif., at the present time does not use packer-type collection vehicles for collection operations. We formerly used them but we converted all of the units and eliminated the load packing feature. City crews collect garbage twice per week from all residential property and daily, except Sunday, from all commercial property. This service is 100 percent backyard collection.

City crews also collect non-combustible refuse once every four weeks from residential property only. This service is 100 percent backyard collection. Both services are financed from the general tax of the City. Combustible refuse is presently burned in backyard incinerators or collected by private collectors, who are licensed.

On and after October 1, 1957, when backyard incinerators were banned, City crews collect combustible refuse from all residential property on a once-per-week schedule. This service will be 100 percent backyard collection. It is planned to use packer-type collection vehicles for this new service.

Experience in Pasadena, using packer-type vehicles has demonstrated that for garbage collection and non-combustible refuse collection, the packer-type unit has no advantages, but has certain disadvantages over a closed steel dump body with sliding loading doors without the load-packer feature.

Collection Data From St. Paul

J. M. COTTER,
Superintendent of Sanitation

Prior to 1953, only about 25 percent of the householders' garbage produced in St. Paul, Minn., was municipally collected—the balance being collected by farmers who used it for hog feeding. In that year, the Minnesota State Legislature passed legislation forbidding the feeding of raw garbage to hogs and most of the hog feeders went out of business. This required the City to procure compactors immediately and to set up a system of collection. The City still uses the original 13 collectors who own their own 5-yd. trucks and who are paid a rate of $4.20 per hour per truck which they must furnish with gas, oil, and insurance. They also receive 15 days vacation and 15 days sick leave each year. These trucks are given garbage routes adjacent to the land fill area and haul two loads per day.

In addition, the City has 15 other routes on which we use 10- and 13-cubic yard compactor trucks. The average load hauled by the private trucks is about three to four thousand pounds. The average load hauled by the compactors is six to seven thousand pounds. We have found it to be most advantageous to use the larger trucks except in the narrow alleys or the areas in which there are steep grades—particularly in the spring months when the frost is going out. The average number of pick ups by the compactors which have two collectors is 550 stops and collections are made from the alley or from the front, should there be no alley in the block. The garbage can is placed within 10 feet of the alley or as directed by the Supervisor of the route. There are no curb collections made in St. Paul—all garbage cans are in the rear of the premises.

The average collection route is four miles, but some of the routes have as high as an 8-mile haul to the sanitary land fill. All of the compactor trucks are stored in the Municipal garage and upon returning to the garage at the end of the day, are steam cleaned, greased and gassed. The budget for the collection of garbage is $550,000 per year, but we find this is insufficient to give more than once-a-week collection service. Our crews work 40 hours per week and get all holidays off. The drivers are paid a scale of $2.37 per hour and the collectors $2.30 per hour. We hope that we can, in the coming year, secure a larger sum in our budget in order that more frequent collections can be made.

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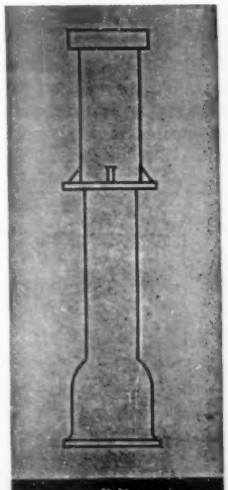

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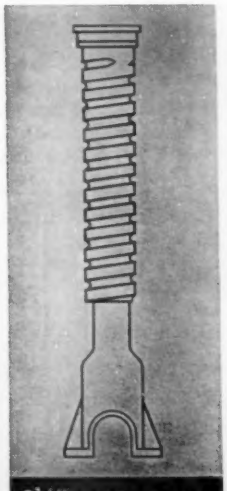

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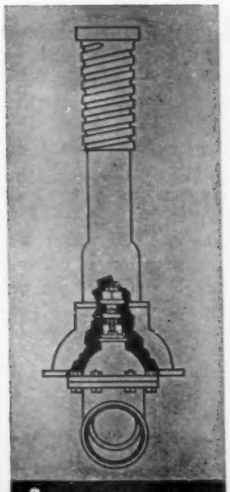

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PUBLIC WORKS DIGESTS

Prepared by

FRANK FORCE

Associate Editor

THE HIGHWAY AND AIRPORT DIGEST

Practices on Highways For Alleviation of Frost Damage

Climatic conditions in Canada are such that freezing temperatures are experienced in all areas to a greater or less extent. The frost damage is apparent in two forms: First, the heaving and warping of road surfaces caused by the growth of ice masses in the soil; second, the loss of bearing strength in the base caused by the excessive water left in the soil during and after thawing. Three conditions must exist to promote frost damage: Freezing temperatures; a source of water; and a soil capable of transporting this water from its source to the freezing zone. The water causing the trouble is not that amount which is present in the soil at the time of freezing, but the extra water drawn into the area by frost action. Frost action may be eliminated by drainage and removal of susceptible soil, or by strengthening the pavement by extra depths of non-susceptible soil. Moisture barriers should be studied and a uniform nomenclature should be established across the country. Highway departments should record winter profiles to establish better understanding of the extent of road heaving.

"Current Practices on Highway For Alleviation of Frost Drainage." By J. A. Knight, Brunner Mond Canada Sales Ltd. *Roads and Engineering Construction*, October, 1957.

Multi-Story Garages

The necessity for off-street parking facilities in the larger towns and cities has long been apparent. Because it is believed that multi-story parking garages are the best answer; and reinforced concrete by its economies, fire resistance and inertness to oil products is the best medium of construction, investigations have been made into their special structural problems. Plenty of material is available for a study of the best current practice; in the U.S.A. particularly there has been a post-war boom in parking garages, and many interesting examples are being built on the Continent. It seems clear that multi-story parking garages are a reasonable commercial proposition, and that the ramp garage is likely to be more so than the mechanical except in special circumstances.

"Multi-Story Garages." By E. G. Kitching. *Contractors Record and Municipal Engineering*, October 23, 1957.

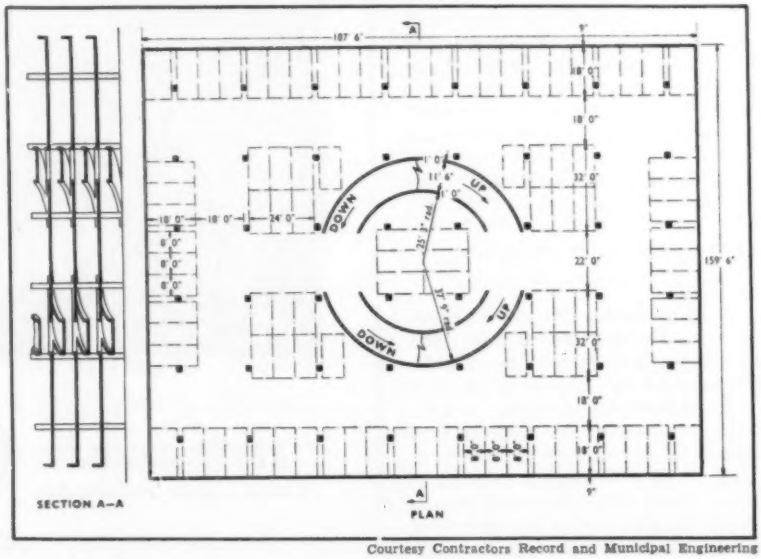
100% Paved Streets For Mobile

Present contracts totalling $13,000,000 call for the paving of all remaining dirt streets in Mobile, Alabama. Three basic types of pavements are being used on the 80 miles of streets to be paved. They are 1) 6-in. soil-cement base with single bituminous surface treatment and 1½-ins. of hot mix asphalt; 2) 6-in. soil-cement base with single bituminous surface treatment and 2-ins. of hot mix asphalt wearing surface; and 3) 6-in. soil-cement base with 2-in. asphaltic binder and 1-in. of hot mix wearing surface. Portland cement is used at the rate of 10 percent, and the soil is pulverized until 80 percent of it, exclusive of gravel or stone, passes a No. 4 sieve. Pulvi-mixers and a P & H stabilizer were used for the mixing with sheepsfoot rollers used for the initial compaction and pneumatic-tired and steel wheel rollers for final compaction. Final operation consists of the application of 0.20 to 0.25 gallon psy of emulsified asphalt as a sealer, before the asphaltic wearing surface is applied. Property owners will pay only $3.50 per lineal ft., about one-fourth the cost, as their share of financing the program.

"100% Paved Streets For Old Mobile." By Joseph N. Langan, City Commissioner, Mobile, Ala. *The American City*, November, 1957.

Operating a County Highway Department

The maintenance program of Scott County, Iowa, is quite flexible. The 11 maintenance districts are each equipped with a 100-hp. motor grader. Other equipment used throughout the county are two



Courtesy Contractors Record and Municipal Engineering

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The P&H Single Pass Stabilization Method requires a minimum of equipment and operators—gives better control of depth—builds roads of more uniform strength and longer life. For your copy of the complete booklet "Low-Cost Highways", write Dept. 512-A, Harnischfeger Corporation, Milwaukee 46, Wisconsin.

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"Mixing of soil and/or soil combinations and additives shall be accomplished by use of a single pass traveling mixing plant of the type which leaves the material spread for immediate compaction."

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Gradalls, one 1-yd. dragline on crawlers, one 1½-yd. end loader on rubber, one 1-yd. end loader on tracks, two "D" Tournapulls and two bulldozers. Nine dump trucks of the 25,000 GVW class rounds out the equipment for the maintenance section. The construction crew has five tractors with 8 to 11-cy. scrapers, two "D" Tournapulls, two bulldozers, two pull-type blades, an elevating grader and rollers. The county quarry is operated by the construction crew with 70,000 tons of crushed rock being produced per year. A centrally located shop is the hub of all crew activities. The chief mechanic directs all equipment maintenance and repairs and does all the parts purchasing with the aid of the shop clerk on a shop order system. The basic survey crew comprises 6 men, with an additional 4 or 5 college students hired for summer work. The party chief is also in charge of Right-of-Way acquisition and this procedure is working out well. The office staff consists of the engineer, two assistant engineers, an administrative clerk and a bookkeeper. The two-way radio system consists of two base stations, seven mobile units and two walkie-talkies. The radios have had a tremendous "streamlining" influence on the efficiency of the work.

"Operating a County Highway Department." By W. G. Harrington, Formerly Scott County Engineer, Davenport, Iowa. PUBLIC WORKS, December, 1957.

Street Paving at Night

The bituminous resurfacing of Superior St., Duluth, Minn., was accomplished between 6 pm and 6 am. The new pavement consisted of 1½ ins. of high-type asphaltic concrete, placed in a single course. Three blocks of the project were carried out at a time with the routing of traffic played by ear, allowing as much access to the street as was feasible, but resorting to detouring to adjacent streets when necessary. "No Parking" signs were attached to the parking meters late in the afternoon in the blocks to be worked on that night. The first night crews prepared for paving activities by cutting out the pavement irregularities with jackhammers. The second night the tack coat was sprayed and three blocks of the street surfaced. Street lights furnished enough light for the construction work. Manholes, catch basins and utility company installations were carefully located, paved over and were raised after the job was completed. They were cut out, raised to the proper grade and concrete poured around them to within 2 ins. of grade. Bituminous material was used to fill the final 2 ins. One disadvantage of the night paving was the delay of the trucks bringing the material from the hot-mix plant in the evening rush-hour traffic.

"Duluth's Main Street Paved at Night." By H. K. Glidden. *Roads and Streets*, November, 1957.

The Lighting of Traffic Routes

While the problem of providing improved lighting is primarily a technical one relating to the selection and installation of suitable light sources and types of equipment, there are, however, administrative and financial considerations facing both lighting authorities and the Ministry of Transport in England. These largely determine the rate at which the relighting of the roads system can be completed. In dealing with the lighting of main traffic routes it is, therefore, necessary to examine some of the administrative and financial problems involved as

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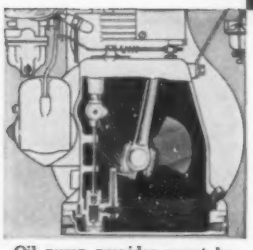
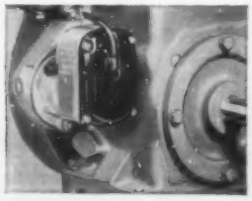


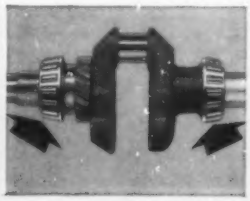
Oil pump provides surest lubrication . . . even when oil is at a very low point.

• Mere eye appeal is not enough when you choose a mower! Your equipment must deliver breakdown-free dependability, hour after hour, day after day even under toughest operating conditions. The mower engine must match this performance, delivering *FULL TIME POWER* always.

Check these *FULL TIME POWER* features found on Wisconsin Heavy-Duty Air-Cooled Engines. Good reasons why your city, town or county government should specify Wisconsin Engine-powered equipment, 3 to 56 hp. Write for bulletin S-212, covering all models.



Weather-sealed magneto is an exclusive feature . . . includes an impulse coupling delivering faster all-weather starts. Magneto replaced in minutes.



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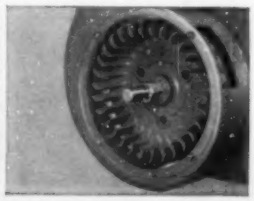

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well as technical considerations and factors affecting the selection of lighting systems to meet the needs of particular installations. The final outcome of the design of any lighting scheme can only be judged by the appearance of the street at night, backed up by photometric tests carried out on the completed installations. Before the relighting of Great Britain's national road system is completed, it will call for the closest collaboration between lighting engineers and those responsible for our highways.

"The Lighting of Traffic Routes." By Granville Berry, M.I.C.E., M. I. Mun. E. *Contractors Record and Municipal Engineering.* November 13, 1957.

The Lighting of Bridges and Tunnels

The lighting of bridges and tunnels for vehicular traffic present almost exactly opposite problems. A bridge has no backgrounds; in a tunnel backgrounds predominate. A bridge has usually a humped vertical curve; a tunnel has often a sagging vertical curve. Bridges are usually straight on plan; tunnels are often curved. Bridges often present a major problem in aesthetics; tunnels are not usually difficult aesthetically. Bridges present no lighting problem by day; tunnels by day present a particularly difficult problem. On bridges the electrical and control requirements are those of normal street lighting; in tunnels there are special requirements for switching, dimming and standby circuits. On bridges normally weatherproof equipment is needed; in tunnels it must be hoseproof under load.

"The Lighting of Bridges and Tunnels." By C. C. Smith, MIEE, FIES., City Lighting Engineer, Liverpool, and J. M. Waldram, BSc, AMIEE, FIES, Research Laboratories of the General Electric Co. Ltd., Wembley. *Roads and Road Construction,* October, 1957.

Taking Care of Trees Along State Highways

Much of the tree-maintenance program in Ohio consists of tree removal. There are trees that can be removed during the winter and those that require immediate attention. The winter group constitutes those trees that have died because of grade changes during the time of road construction. The other group is the one that should be removed at once and burned, such as the ones killed by disease. A tree-spraying program for the control of diseases

INSTANT BRUSH DISPOSAL

FITCHBURG CHIPPER

DOES 3 MEN'S WORK

Charles Morriss feeds roadside brush into Mahwah's Fitchburg Chipper

When you want to cut brush disposal cost, investigate a Fitchburg Chipper, a real time and labor-saver.

John Glasgow, Superintendent of Public Works, Township of Mahwah, New Jersey, says: "Now I chip brush instead of putting it on piles and waiting for wet weather to burn. I mention wet weather because of fire hazard.

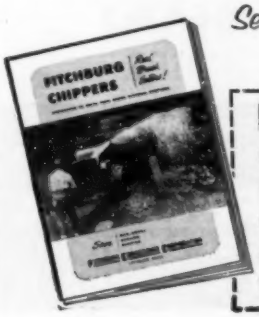
"The Fitchburg Chipper was purchased in May 1954. It will take only a short time to pay for itself. I hired 6 men to cut and clean up brush, now with the Chipper I only need 3 to do the same work."

You, too, can save man hours where there is a need for line clearance operations, road clearance, thinning out woodlots, or handling the brush problem on parkways, city streets, etc.

The Fitchburg Chipper is designed for rugged use, and in models priced from $960 upward.

Learn about Fitchburg's exclusive spring-activated feed plate, which makes chipping of all sizes of wood (up to the machine's rated capacity) simple. Another exclusive feature is the hinged feed apron which can be closed when not in operation.

Read how others cut labor costs with a Fitchburg Chipper—the only chipper that gives you a one-year guarantee.



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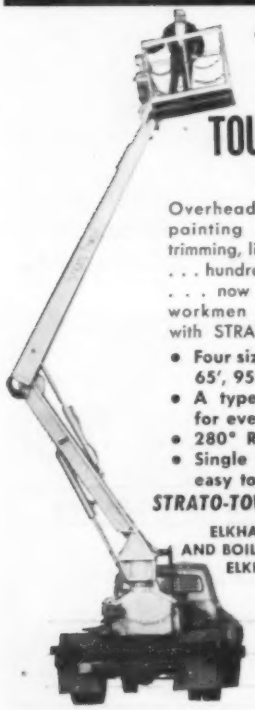

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Overhead jobs . . . painting . . . tree-trimming, light-servicing . . . hundreds of others . . . now reached by workmen in seconds, with STRATO-TOWER!

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and insects is carried out. For eating insects, a lead-arsenate spray is used. A 12 percent solution of DDT is used as a dormant spray to control Dutch elm disease. The temperature must be above 40° when this solution is applied and it is followed with a 1 percent solution of a chlorate the last of May or when the tree is in full foliage. Fire blight is controlled by using phytomycin and for Taxus Mealy bud malathion and paratheon is used. Dieldrin is used for the Japanese beetle and malathion for aphids and plant lice. Satisfactory results for leaf minor are obtained by using DDT, 50 percent wettable powder, about May 15 for northern Ohio or when in full foliage. In planting a tree, the tree should be well grown and the planting specifications should follow good horticultural practices. Wrapping of the trees is a practice followed by the state. Roadside trees not only add beauty, but they help motorists drive more safely, thus making automobile travel more relaxing and more enjoyable.

"Taking Care of Trees Along State Highways In Ohio." By Wilbur J. Garmhausen, Chief Landscape Architect, Ohio Dept. of Highways. *Better Roads*, November, 1957.

Design and Maintenance of Roadside Parks

A roadside rest area, park or picnic area turnout is a small roadside area served with a drive and parking facilities. The area is usually provided with shade, toilets, drinking water, picnic fireplaces and picnic tables. A park site some distance (five miles or more) from a city or large town is easier to maintain; however, in order to secure water and shade a number of park areas are located adjacent to small towns. Advance warning signs help to accomplish safe entrance into the parks with the three type signs being used: Roadside Park 1 Mile; Roadside Park 1000 Feet; and Park Entrance. Detailed landscape plans are prepared of all park areas with contour lines, trees and other items. Entrances should be a minimum of 36 feet wide and should be spaced 350 to 500 feet apart. The park drive may parallel the highway, separated by a long narrow traffic island. The maintenance of the parks include emptying trash cans, checking toilets, picking up debris, replenishing firewood, mowing grass, patching driveways, and painting picnic tables. Deceleration lanes and acceleration lanes for safety turnouts on the Kansas Interstate System will be built as set forth in the AASHO

"Policy on Geometric Design of Rural Highways."

"Design and Maintenance of Roadside Parks." By Franklin T. Rose, Landscape Architect, State Highway Commission of Kansas. PUBLIC WORKS, *December*, 1957.

Other Articles

"The Riding Quality of **Concrete Roads**." By Reginald A. Kidd, B.S.C., M.I.C.E., Mun. E., County Surveyor of Nottinghamshire, The Surveyor and Municipal and County Engineer, October 26, 1957.

"Lessons From **Cold-Weather Concrete Failures**." By H. J. Racey, Racey, MacCallum and Associates Ltd., Montreal, Canada. Civil Engineering, November, 1957.

"Modern **Seed and Mulch Application**." By C. Tackaberry, Maintenance Engineer, Ontario Highways Dept. Roads and Engineering Construction, October, 1957.

"**Traffic** and **Travel Trends, 1956**." By Thomas B. Dimmick, Supervising Transportation Economist, Bureau of Public Roads. Public Roads, December, 1957.

"**Grand Forks Runway** Finished in 5 Months." By Ralph J. Smith. The Constructor, November, 1957.

"Colorado Increases Use of **Prestressed-Concrete Design**." Schedule now includes 15 structures, with more to come. By Allyn D. Newbold, Bridge-Design Engineer, Colorado Dept. of Highways. Better Roads, November, 1957.

"Results of Tests With **Rubber-Asphalt**." By W. Richter, Chief Engineer of the Rijkswaterstaat (Noord-Holland, Haarlem). Roads and Road Construction, October, 1957.

"**Europe's Longest Runway** Nears Completion." Rome's new airport has soil-cement base. Highways and Bridges and Engineering Works, October 16, 1957.

"Guides in Selection of **Freeway Interchanges**." By P. R. Tutt, Senior Designing Engineer, Highway Design Division, Texas Highway Dept. Texas Highways, October, 1957.

"Specialized **Weather Forecasts Guide Winter Operations** on Ohio Roadways." Private weather service alerts headquarters of Ohio Dept. of Highways; information is radioed to division to be hit by adverse weather. Contractors and Engineers, November, 1957.

"**Dust Control**." This article discusses the recommendations for the effective use of calcium chloride, sodium chloride and bituminous materials for dust control. By John W. Hutchinson, Civil Engineering Dept. University of Illinois. Public Works, December, 1957.

Getting TRAFFIC-SAFE Pavements

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You can get those **Traffic-Safe driving conditions Faster and Cheaper** if you use the **"Scotchman" Method** of Ice and Snow Control . . . spread de-icing salts Early, Thin and Wide.

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ELECTRIC PLANT NEWS

Onan ELECTRIC PLANTS

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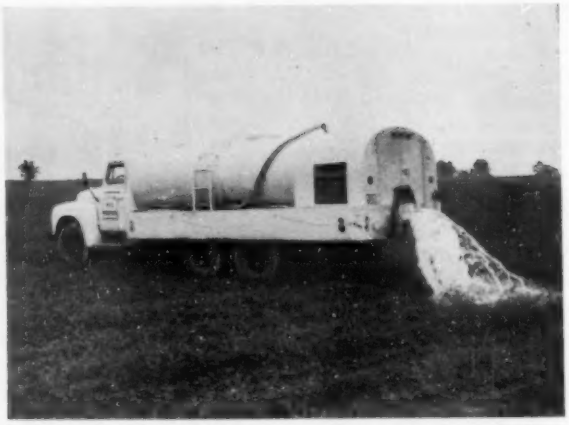
Onan ELECTRIC PLANTS

● IN THE CITY—this Seaman-Gunnison flusher is used to flush streets in Woodstock, Ill., on a once-a-week basis.



● IN THE COUNTRY—the same unit hauls lime sludge from city water softener plant to help condition soil on farms.

City Flusher Solves Lime Sludge Disposal Problem

DISPOSAL of lime sludge from the municipal water softening plant is no longer a problem in Woodstock, Illinois. Instead, the city-owned street flusher truck is used to spread the lime on nearby farms, a service performed at no cost to the farmers.

The flusher, a Seaman-Gunnison of 2,000 gallons capacity is used twice weekly to flush the business district and once each week to flush the streets of the entire city. Most of this work is accomplished by 9:00 a.m. For the remainder of the day the flusher is used to spread the lime sludge, which is much in demand by farmers as a soil conditioner. The truck loads up with 2,000 gallons of sludge and precedes to a farm where the load is distributed through a 6-in. nozzle mounted at the rear of the truck. It takes about five minutes to discharge the contents. Needless to say, the waiting list for the sludge is long.

City Manager Pete A. Pakey writes, "The City of Woodstock hauls approximately 20,000 gallons of sludge per day, with a maximum haul within a 2½-mile radius of the city limits. It is estimated that approximately 4,000 gallons of sludge is applied per acre."

Arthur Share, Superintendent of Public Works for Woodstock says, "The flusher unit is never idle. The purchase of such a unit is a large investment for a city of this size, but because of its versatility and dependability, we've made this investment pay off many times over."

Town and Village Consolidation in Vermont

RICHARD F. CAHILL,
Town Manager,
Northfield, Vt.

AN OLD LAW enacted by the Vermont legislature allows residents of a municipality to form a special governmental unit, whether village, fire district, water district, etc. The purpose of this law was to permit residents of a municipality to obtain special benefits, including protection, fire protection, sewer service, water service or whatever else desired. Special governmental units or areas were thus created.

For a period of years this seemed like the desirable thing to do for a municipality wherever the people were in need of special service; but now these special districts have created hardships for local administrators, planners, and taxpayers. For instance, the residents of these special districts now are faced with the burden of paying taxes on two local governments: The special district and the original area called the township.

With the expansion of industries, new homes and population growth most communities now find that the only solution to more effective and efficient government is to have one and only one government. The problem is essentially that of consolidation of the two governmental units. This seems to be the ultimate solution to the problem. Perhaps it is, but the first step in consolidation must come from the authorization of the people affected.

Several Vermont municipalities have undertaken the initial step: The selection of a committee to study the effect of consolidation and the drafting of a charter in the event the districts affected will vote in favor of consolidation. Last, but not least, is the method of establishing an equitable tax rate for the consolidated municipality in the event the voters of the two areas vote in favor of merging.

One of the most important questions asked by the citizens is: "Will consolidation affect my taxes, and if so will consolidation increase or decrease my taxes?" The answer is this: The primary purpose of consolidation is to try to reduce taxes, but to give a taxpayer this written guarantee prior to consolidation is quite an impossibility.

At the present time the tax rate of the village of Northfield is approximately 15 percent more than the town rate. It seems as though a decrease in the town property assessment by approximately 15 percent and the application of the village tax rate would be both a psychological method and a fair method of adjusting the taxes for the two districts affected. This would provide a means of obtaining the same amount of taxes with no increase in either property assessment or property taxes.

The 1957 Vermont State legislature provided a means of voting for consolidation—mainly that of having the two districts vote separately. Before consolidation goes into ef-

fect each district must vote in favor of consolidation.

Recently St. Johnsbury, Vt., voted on the consolidation issue. Approximately 700 votes cast in the village were in favor of consolidation; approximately 130 votes out of 250 votes in the town rejected the merger of the two units. This is a case where the minority rule; and voting again on consolidating will have to wait another year. It seems as though St. Johnsbury will have to stress and instill in their town residents more information in regards to consolidation before they will accept a favorable vote on the issue.

Northfield has set a date in the early part of 1958 to vote on consolidation of the town and village of Northfield.

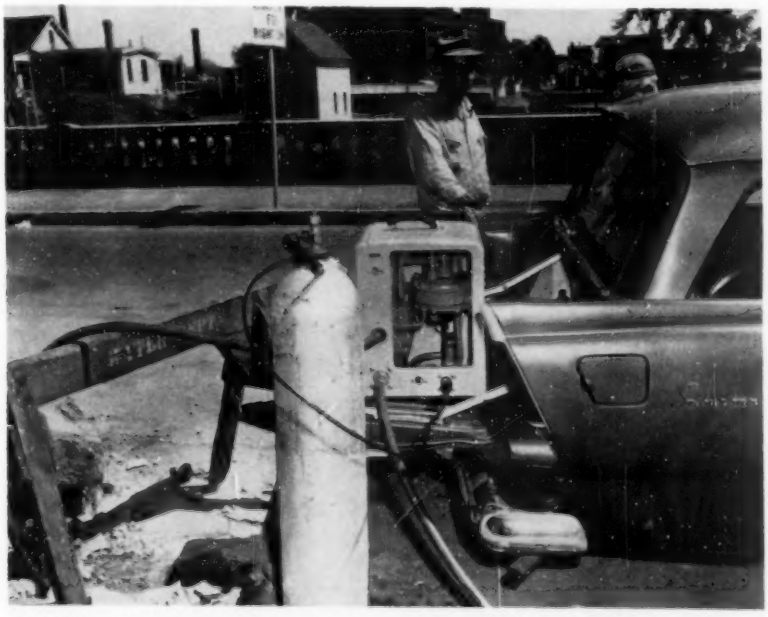
MAIN STERILIZATION SIMPLIFIED

AS EVERYONE familiar with the installation, repair and maintenance of water mains knows, main sterilization is a must. On large mains, however, it is often a troublesome and time-consuming job.

Recently the City of Lawrence, Mass., cleaned and relined some of its larger mains to improve distribution capacities. It was decided to use gaseous chlorine for sterilizing these mains to hold chlorinating time and chemical costs to a minimum, and for assistance on this work, Carroll J. Cheslousky, Field Engineer of Fischer & Porter Co. was contacted. He advised the use of a portable gas chlorinator and offered to lend one of the units which he keeps on hand for demonstration and in case of local emergency.

When the first sections of cement-lined pipe were ready to go back into service, the portable chlorinator was set up for the operation. This involved simply connecting a chlorine cylinder and a water supply line to the back of the chlorinator; and a chlorine solution line was attached and connected to the water main. After these connections were made the water supply to the chlorinator was turned on, and the chlorine feed rate was set to provide chlorine solution at a concentration of approximately 50 ppm. Water flow through the chlorinator was stopped, automatically stopping the chlorinator, when the main was filled. Following this the connections were broken and the chlorinator was carried to the next sterilization point. Ten minutes were all that were required for each connection.

Everyone concerned was favorably impressed by the performance, ease of portability, simplicity of installation on the job and the highly important safety feature of positive gas flow shut off in case of damage to the unit.



● MAIN sterilization set-up with the Fischer & Porter portable chlorinator.

Dodson's Digest

How to make ice disappear like magic

Stopped in to see Al Russell on my last trip up North. Al is a county road commissioner, and also a pretty good amateur magician.

"How's tricks?" I asked him.

"I'm working on the hardest trick I know, Dod," he replied. "I'm trying to keep my ice-control costs down. I can't do it with mirrors, so . . . "

"I know the secret of that trick, Al," I broke in. "It's all done with pellets."

"What kind of pellets?" Al asked.

"Calcium Chloride pellets," I explained. "They're free-flowing, so they're easier to handle and spread. This cuts your labor cost, and . . . "

"That's a pretty good trick in itself," he admitted.

"What's more," I went on, "Calcium Chloride pellets do a better job of removing ice from highways. Because they're practically anhydrous, Calcium Chloride pellets generate a lot of heat when they go into solution. This heat, and the special shape of the pellets, cause them to bore right through the ice, breaking the bond between the ice and the road . . . making it easier to blade away."

"And some of the ice would even be swept off by passing traffic," Al mused, stroking his chin.

"On top of that," I continued, "you can buy Calcium Chloride pellets in bulk, and store them. This eliminates package costs, cuts loading time . . . "

"You know, Dod," Al said. "I'm beginning to think that you're a better magician than I am."

"Nonsense," I protested. "Why, I've seen you saw a woman in half, and never even draw blood."

"That's nothing," Al grinned. "You just cut my ice-control costs in half, and kept traffic flowing through every main artery in the county!"

— L. D. Dodson

P.S.—Our Calcium Chloride pellets can help cut costs in *your* ice-removal operation, too. Find out all about them in our new booklet, "Pellets . . . a New Form of Wyandotte Calcium Chloride." To get your free copy, just drop me a line. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

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MICHIGAN ALKALI DIVISION

HEADQUARTERS FOR CALCIUM CHLORIDE

PUBLIC WORKS DIGESTS

Prepared by
ALVIN R. JACOBSON, Ph.D
Associate Professor and Head,
Division of Sanitary Science,
Columbia University School of Public Health

THE WATER WORKS DIGEST

Underground Storage Reservoirs

Underground reservoirs have an important part in the economical supply of water, especially in their ability to provide for continued normal service during periods of unusual demand. This paper describes the problems in Metropolitan Toronto and the design bases used there, treating especially valve or gatehouse design and of roof and footing drainage. The value of such underground storage reservoirs in civil defense are considered.

"Design of Underground Storage Reservoirs." By Allan B. Patterson, *Journal of the American Water Works Association*, November, 1957.

County Water Authority in Pa.

Westmoreland County—the only county in Pennsylvania with a water authority—has eliminated all fear of water shortages which have seriously affected thousands of communities in recent years. The record is the result of long-range planning to provide Westmoreland County with a modern up-to-date water system. The authority acquired three water systems serving many of the communities throughout the county. After the acquisition of these properties, the authority embarked upon an ambitious and successful program of improvement and integration of these systems into a county-wide water system. The major elements of the improvement program included the construction of an impounding reservoir having a capacity of 9.2 billion gallons with a dependable daily yield of 30 million gallons; a 10-mgd capacity filter plant; low and high-service pumping stations; pumping equipment and approximately 21 miles of pipes ranging from 12″ to 36″ in diameter leading to the Vandegrift and Westmoreland system, two of the systems recently acquired; 180 miles of distribution system integrating the three major systems and furnishing water to many newer communities which had been without public water supply systems; an 11-mile industrial water transmission system of 30 to 42-inch diameter prestressed concrete pipe to supply unfiltered water to industries along the highly polluted Kiskiminetas River; and four steel storage tanks with a total capacity of 7,700,000 gallons. The number of customers being served has increased from 4,644 to 41,276 during the 14 years of growth of the Westmoreland County Water Authority.

"From 4,644 to 41,276 Water Customers in Fourteen Years of Planned Growth." By J. L. Matthews. *Water Works Engineering*, November, 1957.

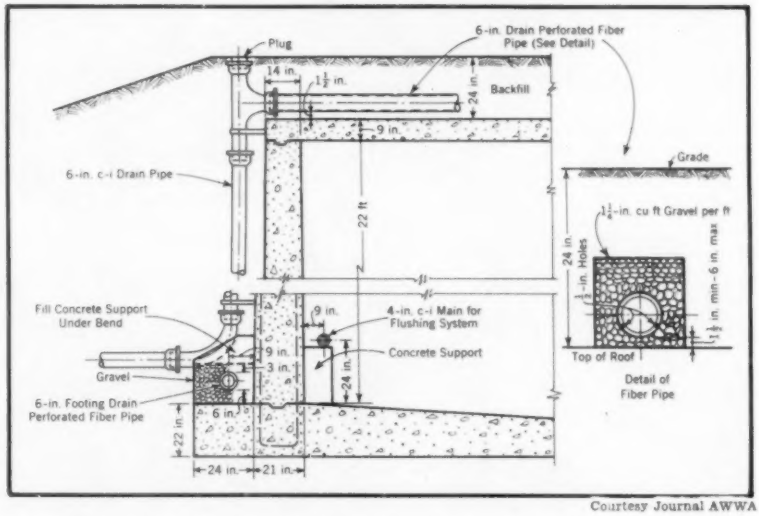
Research in Sanitary Engineering

These fourteen articles on research in sanitary engineering are designed to provide a cross-section of what is going on in this important field. Articles relating to water include: An account of the work that is being done at the Robert A. Taft Engineering Center on coagulant aids and on the methods of water treatment to combat transmission of human virus disease by water; studies on corrosion by Werner Stumm of Harvard; tastes and odors in drinking water, with special reference to phenols, by Richard Hoak; detergent breakdown and the effects on water quality and water treatment as reported by P. H. McGauhey; iron and sulphur bacteria studies at the University of Florida, reported by Prof. John E. Kiker, Jr.; reactions involving oxy-chloro compounds, especially chlorine dioxide, in water treatment reported by Marvin Granstrom and G. Fred Lee of the University of North Carolina; new concepts of sedimentation for both water and sewage by William E. Budd of Dorr-Oliver; and toxicity investigations on aquatic and marine life reported by Jack Garrett.

"Highlights of Research in Sanitary Engineering." Reports on research by the Federal Government, Universities and industry coordinated by Dr. D. A. Okun. PUBLIC WORKS, December, 1957.

Watershed and River Protection

Some of the factors to be considered in the protection of our water resources are enumerated and



Courtesy Journal AWWA

● **PERFORATED PIPE may be used for drainage of footings and roofs of reservoirs.**

Aerators, Degasifiers, Deaerators

If you want to remove dissolved gases or iron or taste and odor from large quantities of water, you will probably use aeration or degasification as part of the treatment.

Modern equipment for putting air or gases into water or taking them out is highly specialized, ranging from simple, low cost aerators to complex, highly efficient degasifiers.

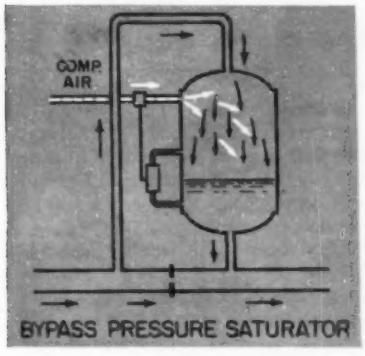
The following descriptions may help you choose the type of equipment that best solves your problem at the lowest cost.

To introduce air

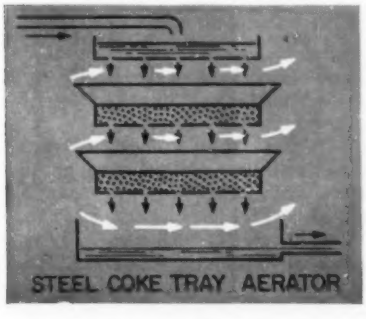
If your problem is simple introduction of air to oxidize iron or manganese, **pressure aeration** may be preferred to avoid repumping. But introducing air into water under pressure can result in supersaturation when the pressure is reduced, causing "milky water" and filter troubles from air binding or upset beds.

A Bypass Pressure Saturator automatically provides aeration without the danger of supersaturation by introducing air to only a predetermined portion of the total flow. (Patented by Permutit.)

If you want to reduce CO_2 or taste and odor or accomplish any of these at the same time that you oxidize iron or manganese, an **aerator** is recommended.

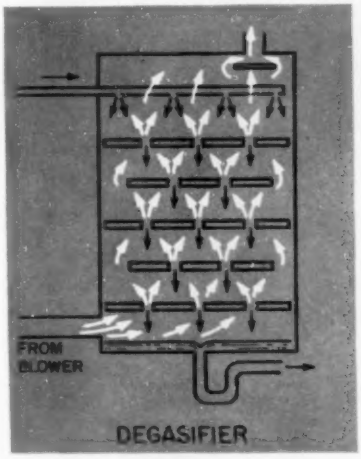


Aerators may be of the open type in which water cascades over trays of graded coke or a series of wood slat trays. Splash aprons reduce splashing, permit free circulation of air. Formation of iron or manganese film on coke surfaces hastens oxidation reactions. Some reduction of CO_2 may also take place, raising pH and further helping oxidation.



To remove dissolved gases

For practically complete removal of CO_2, methane, hydrogen sulfide or other gases, the most efficient way is by a **degasifier.**



In a degasifier, water rains down through Raschig rings or wood slat packing countercurrent to a large flow of air from a blower. Thus the freshest air contacts the effluent water, gives lower final gas content. Proper packing design breaks water into thin films, promotes rapid and efficient gas removal.

Degasifiers are totally enclosed, avoiding splashing and spray losses. Outer tank may be of wood, rubber-lined steel, stainless steel or aluminum. Cylindrical units are usually more economical, but square or rectangular shapes may be used. Sizes and capacities are practically unlimited, depending on requirements. Units can be used for water with CO_2 as high as 3500 ppm.

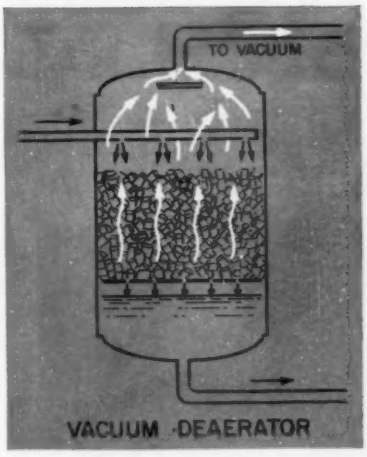
Although degasifiers provide very complete aeration, their higher cost is unwarranted in many cases where simple introduction of air is the main objective.

To remove oxygen

If you want to remove oxygen without heating the water, use **vacuum deaeration.**

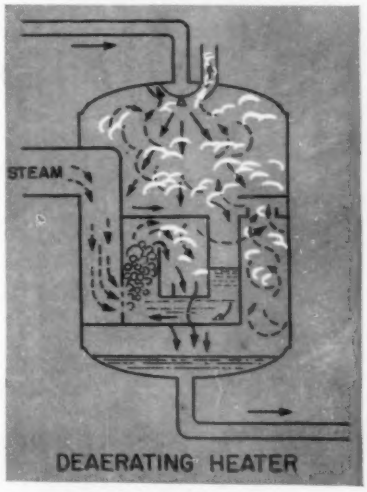
A vacuum deaerator is a steel tank lined where necessary and containing suitable packing such as Raschig rings. A vacuum is maintained in the tank by steam jet ejectors or motor-driven vacuum pumps. Under a vacuum, solubility of gases in water is greatly lowered. As the water trickles down through the packing, the gases present, including oxygen, nitrogen and carbon dioxide, are liberated and drawn off. Type and depth of packing, degree of vacuum, flow rates and other variables must be accurately adapted to your specific conditions for best efficiency.

If the water is to be heated as for feeding boilers, a vacuum is not necessary, and a **deaerating heater** is recommended.



In a spray type deaerating heater, the water is first sprayed through steam which removes most of the non-condensable gases. (The gas-laden steam is condensed and vented.) The water is then reboiled by passing steam through it for final deaeration.

Where less complete removal of oxygen is required, the reboiling (scrubbing) stage may be omitted.



For detailed information on these or any other types of water-conditioning equipment, write: The Permutit Company, Dept. PW-1, 50 West 44th St., New York 36, N.Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

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discussed in this article. The study of a river and its watershed is an extremely fascinating one involving some knowledge of geology, hydraulics, agriculture, chemistry, animal husbandry, meteorology, biology and physical geography, as well as sanitary engineering. Reservoir management involves the many factors of contingent land use, sanitation, siltation, pollution, recreation and the general factor of public relations. Pollution abatement involves the elimination of known sources of pollution, the prevention of new sources of pollution and the full utilization of the self-purifying capabilities of the receiving streams. All these factors must be carefully considered adequately to meet the future needs of this country with our existing water resources. Technical advances in the water purification industry will continue to be made, but it is questionable whether the industry can continue to remain ahead of the increased pollution loads being discharged into the streams. The problem of water quality has been labelled as a "rat race" between pollution on the one hand and purification and treatment on the other, with the margin of safety, in general, narrow and oftentimes precarious. The water works man and the industrial engineer would prefer a frank approach to this question which they would like to pose to their civic leaders: "Are you willing to have this river become an offensive water course as a part of the price of industrial development of the river basin?"

"Watershed Protection, Reservoir Management and Pollution Abatement." By Wendell R. LaDue, *Water and Sewage Works*, November, 1957.

1. Large illustration shows Singl-use Fiberform ready to be filled.
2. Filling plate and collar simplify pouring concrete into form.
3. Completed meter box barrel.
4. Meter box with cover in place.

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Ground Water Recharge

The Illinois State Water Survey with the cooperation of the Illinois State Geological Survey have made a concerted effort of studying the water resources of the state. For the past six years or more studies have been made on ground water recharge pits that have been constructed along the Illinois River. The untreated river water, with the exception of addition of chlorine and filtration through fine screens, has flowed by gravity to the recharge pits for percolation back into the ground water supply. Recharge results have been checked and recorded at 23 municipal and industrial wells. Hourly records are maintained on water levels, temperatures and chlorination. Chemical and bacterial tests are made routinely. The results of six years of operation are are shown in a table. The success of the project has stimulated the construction of two other ground recharge pits in the Peoria area by private industry.

"Recharge of Ground Water at Peoria, Illinois." By T. E. Larson, Max Suter and Orville Vogel. *Water and Sewage Works*, November, 1957.

Good Comparison— MPN vs MF Results

A comparison study of coliform densities has been made at the water plant at Wilkinsburg, Pa., by running parallel tests using the standard dilution tube (MPN) method versus the millipore filter (MF) method. Comparative results of parallel MPN tests and MF tests were made on samples of (1) raw Allegheny River water, (2) prechlorinated water, and (3) water that had been prechlorinated, coagulated and settled. The 219 parallel tests on the raw Allegheny River water showed an 83.5 percent agreement (95 percent confidence limit applied) between the two methods. Comparison of parallel results for

coliform bacteria on 315 samples of prechlorinated Allegheny River water showed 88.4 percent agreement (when the 95 percent confidence limit was applied). Statistical analysis was not applicable on the comparative results of the 315 samples of prechlorinated, coagulated and settled water because of the relatively few samples showing coliform organisms. The above data indicates that the MF technique using an Endo broth in a one-step transfer system has given results comparable with the MPN results obtained with the standard multiple-dilution tubes.

"Comparison of Standard Dilution and Membrane Filter Methods." By Reginald B. Adams. *JAWWA*, November, 1957.

Other Articles

"Design Factors for **Effective Settling** of Coagulated Water." By Rolf Eliassen and E. Alan Cassell. Water Works Engineering, November, 1957.

"**Water Softening**—Part 2. The Lime-Soda Process." The forty-third of a series. By George E. Symons, Ph.D. Water and Sewage Works, November, 1957.

"Photometric Determination of **Color** and **Turbidity** of Water." By A. T. Palin, Ph.D. Water and Sewage Works, November, 1957.

"Digital **Remote Control** and Telemetering System." By J. R. Burgard and D. E. Wassall. Water and Sewage Works, November, 1957.

"Influence of Bicarbonate Ion on **Inhibition** of **Corrosion** by Sodium Silicate in a Zinc-Iron System." By Henry L. Shuldener and Leo Lehrman. JAWWA., November, 1957.

"Recent **Meter-Setting** Developments." A panel discussion presented at the Annual AWWA Conference, Atlantic City, N.J. JAWWA, November, 1957.

"Status of **Fluoridation** in the United States and Canada." A report of Task Group 2620P—Fluoridation Materials and Methods, Philip S. Phillips, Chairman. JAWWA, November, 1957.

"Future Developments in the **Greater Winnepeg Water** District." JAWWA., November, 1957.

"Telemetering and **Remote Control** by the Long Island Water Corporation." Samuel C. McLendon and Michael Zihal. JAWWA., November, 1957.

"How a City Cut **Water Costs**." By Phil Hirsch. Public Works, December, 1957.

"**Corrosion Studies**." By Werner Stumm. Public Works, December, 1957.

"Origin of **Tastes and Odors** in Drinking Water." By Richard D. Hoak. Public Works, December, 1957.

"Advancement in **Bacteriology and Analytical Methods**." By John E. Kiker, Jr. Public Works, December, 1957.

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4. Operating cost compares favorably with conventional sand.

Less than 0.2% of water is required to sluice and clean the Model SCJ filter. The largest filter units can be cleaned and a new fresh diatomite pre-coat applied and the filter back in operation in 20 minutes or less.

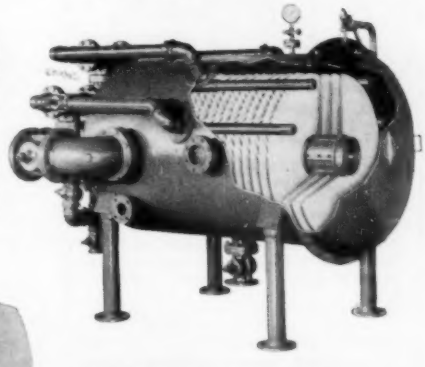
Operators can be easily trained to handle this filter, no highly skilled specialized personnel is required to insure efficient performance.

Sparkler Model SCJ filters can supply practically any required volume of city water. Single units with a capacity of 5,000,000 gal. per day are available. Multiple units including a standby filter is usually employed to insure uninterrupted service for large volume requirements.

Modern electronic control instruments are readily adaptable to these filters, making uniform high quality water supply sure and automatic.

The startlingly low original cost, simple operation, and positive, consistent high quality filtration makes the Sparkler Municipal Water Works filtration system worthy of the most thorough consideration by water works engineers.

Interior construction of Model SCJ Water Filter. Sparkler filtration engineers have introduced, in the SCJ filter, new principles of diatomite filtering that are much superior to old methods and comprise the most advanced innovations in recent years.



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To enable the tractor to move over swamps and through scrubland it was equipped with half-tracks. Also, the Sherman unit was modified for the marsh work by installation of telescopic stabilizers.

The Commission spends $150,000 each year in its war with the mosquito. Use of the Sherman Power Digger makes it possible for the Commission to stretch its budget because of the unit's low cost of operation and saving in labor.

● **POWER digger launches attack.**

INVESTIGATIONS on WATER CONSUMPTION and WATER RESOURCES

W. FRED WELSCH
Senior Hydraulic Engineer,
Div. of Sanitation and Water Supply,
Nassau County Dept. of Public Works,
Mineola, New York

The following article is condensed from an address presented before the Annual Convocation of the personnel of the New York District of the Water Resources Division, United States Geological Survey, at Albany, N. Y.

WITHIN a comparatively short span of years Nassau County, New York, has undergone a complete change of character. Almost overnight, farmlands have been turned into communities of thousands of homes, shopping centers, colleges, schools and industries. While farmland has decreased, farm irrigation has increased to obtain a better yield from remaining acreage. No county in the United States has grown so rapidly. The population of Nassau County in 1930 was 303,053 (Federal Census); on January 1, 1957, the Long Island Lighting Company estimate was 1,146,077, an increase of 843,024. In addition there has been an increase of 250 percent in industrial plants. The phenomenal population growth, with its more than 300 percent increased demand for water, has been successfully met. Light industry is now the core of the economic development; previously it was housing, but the picture has changed.

Our county officials are familiar with the problem of keeping pace with the demand for water during a period in which the curve of population growth is moving constantly and rapidly upward, and with many new appliances or techniques of production that increase more and more our water requirements. There are now fifty public water supply systems in the County consisting of water districts, villages and private water supply companies.

Definite steps have been taken to prevent pollution and contamination of the fresh water streams in the County. The Long Island State Park Commission in 1925 obtained surface easements of practically all the city owned water supply areas on the south shore so as to protect the streams and their boundaries and to furnish park and recreation areas along them. Additional lands bordering on these streams nearly to their source were acquired from private owners by purchase, or, in some cases, by eminent domain.

As population increased, more and more streets were paved; homes, schools, churches and commercial and industrial buildings in great numbers were erected, and

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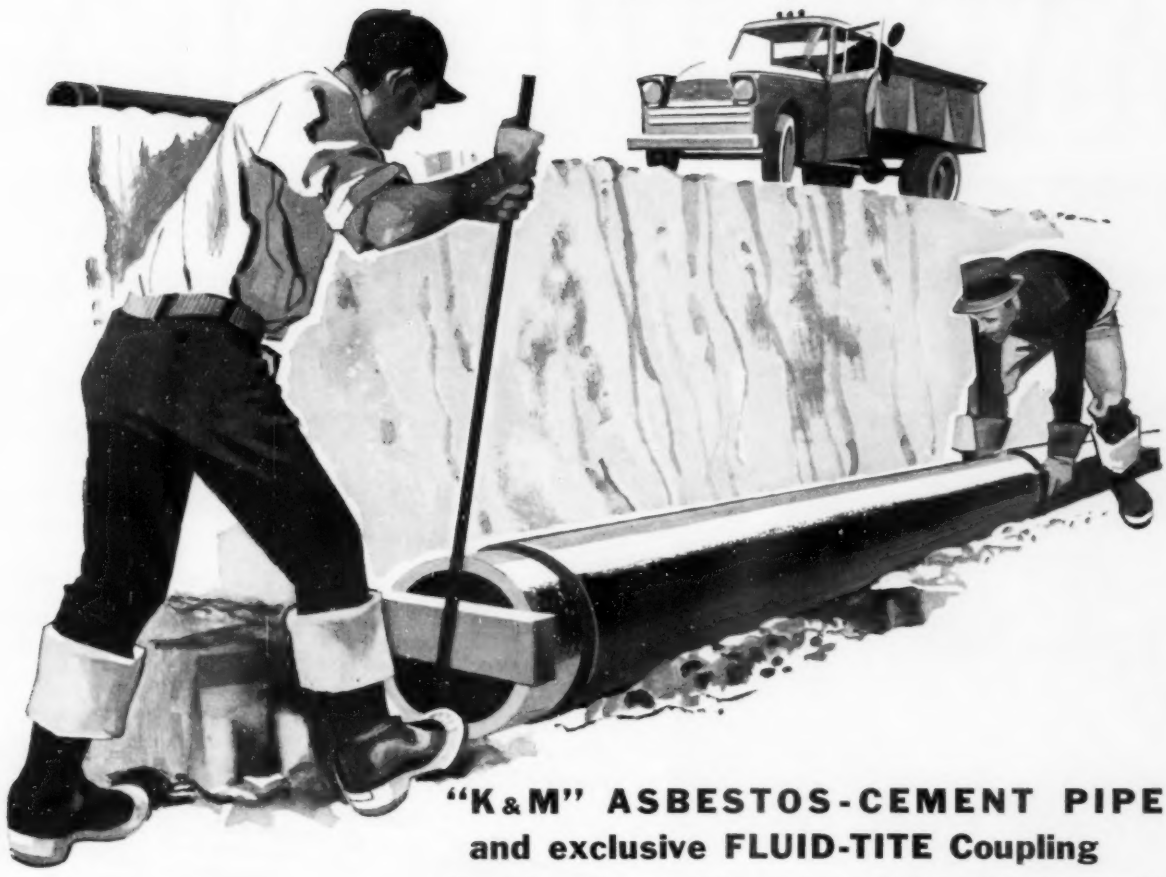

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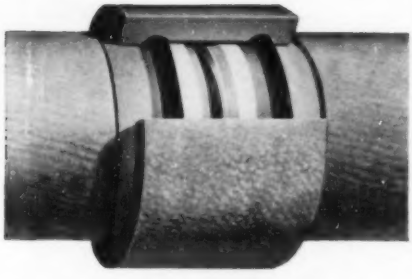

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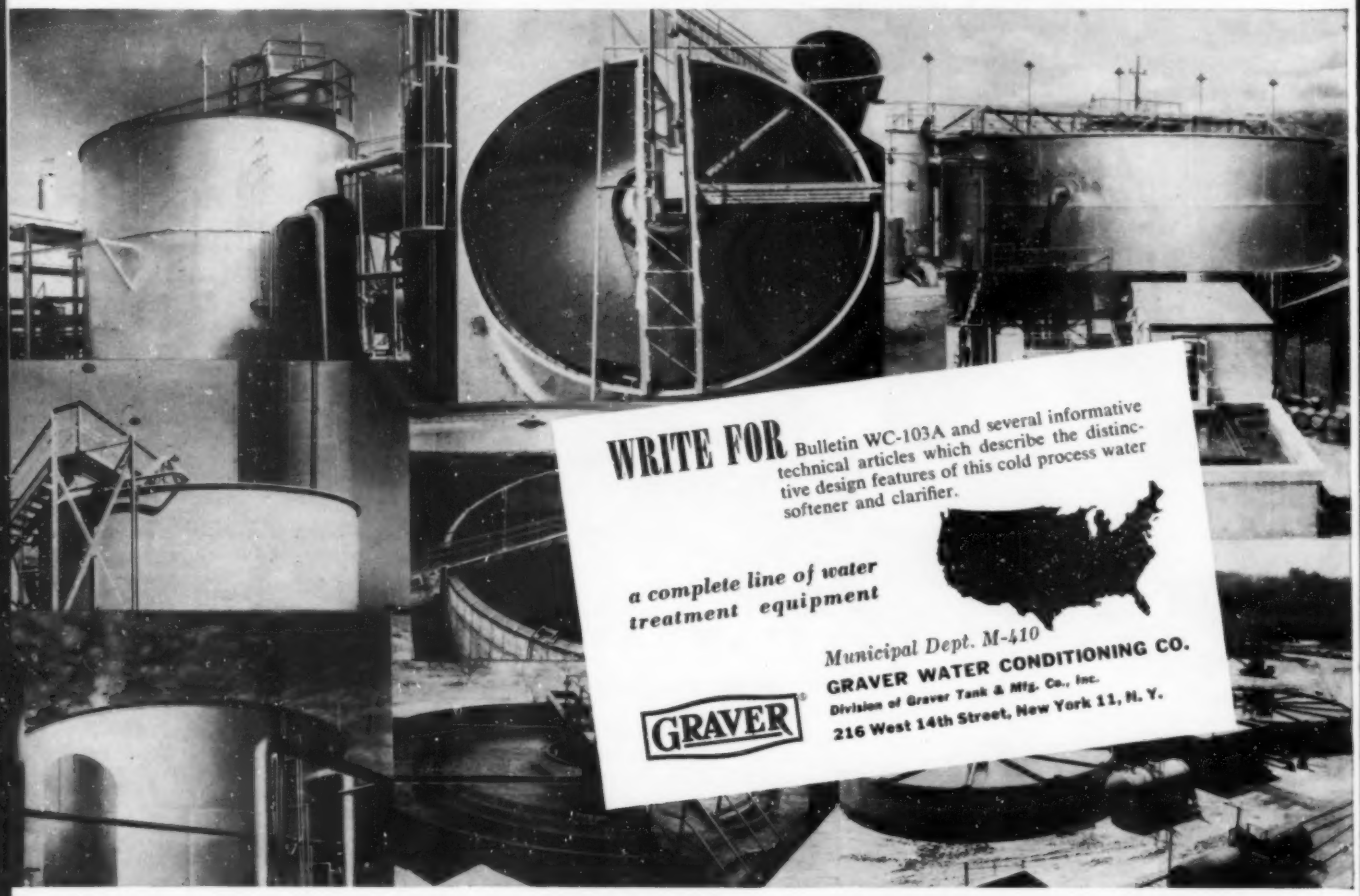
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sanitary sewers and storm drains installed. The run-off of rain waters from pavements and roofs greatly increased, and instead of natural percolation into the ground, was carried away by storm sewers to tidewaters. The pumping levels of ground water wells decreased. The need was to devise a plan, a system of drainage that would restore rainfall to the soil and maintain the ground water at stable levels.

In 1933, the State Legislature enacted an amendment to the Conservation Laws placing the apportionment of ground water resources of Long Island under the jurisdiction of the Water Power and Control Commission Division of the New York State Conservation Department. Since 1932, Nassau County has been engaged in the investigation of ground water resources, and since 1936 in the investigation of surface water resources in cooperation with the United States Geological Survey and the Water Power and Control Commission.

In anticipation of continued population increase, the Nassau County Board of Supervisors authorized, in 1936, the development of a long range drainage plan and water conservation plan which was prepared for the then existing Nassau County Sanitation Commission (Board of Supervisors) under the author's direction.

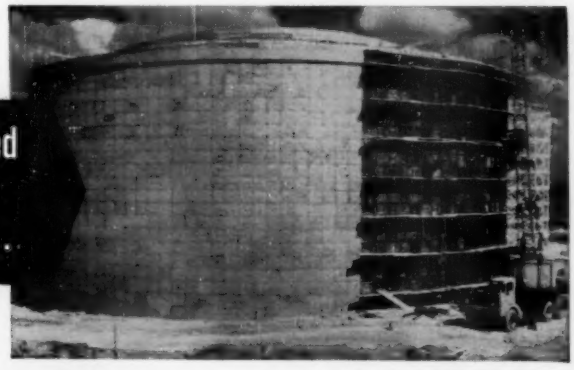
This plan provided for the construction of artificial storm water recharge basins of one acre or more in size in areas where feasible, as a conservation measure to replenish ground water storage. Under this program, 405 recharge basins have been developed with successful performance. These recharge efforts have resulted in saving millions of gallons of storm water which otherwise would have been wasted to tidewater. Large diameter precast diffusion pipe wells with flared openings have been installed to drain small tributary areas; also in several artificial recharge basins to augment seepage.

Cooperative Survey Program

Cooperative activities with the United States Geological Survey over the years have accomplished much with particular reference to the following:

(1) Ground water problems involving a determination of the occurrence and quality of water in geologic formations and estimates of the productivity of wells. (2) Salt water encroachment in potentially critical areas which involve interrelationship between ground water movement and surface waters; outpost observation wells in proximity to shore lines to determine fluctuation of static levels and chloride content. (3) Estimates of how changes in stream flow affect ground water conditions and measurement, and systematic records of surface discharge and ground water flow and quality of water. (4) Relative practicability of developing surface and ground water for particular needs. (5) Investigation of ground water pollution from industrial wastes. (6) Research work and reports on an experimental storm water recharge basin at Garden City. Rates of infiltration have been determined under different conditions; also related meteorologic, geologic and hydrologic data, including evaporation of water from a land pan and floating pan, the first experimental project of this kind on Long Island.

Current efforts to conserve ground water supplies include recharge basins, storm water diffusion wells, diffusion wells for cooling and air-conditioning waters, industrial waste treatment and water re-use and governmental agency study and control.



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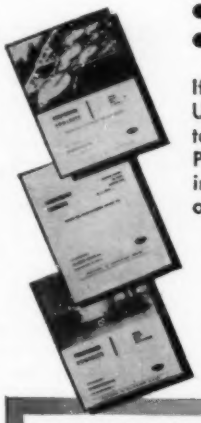

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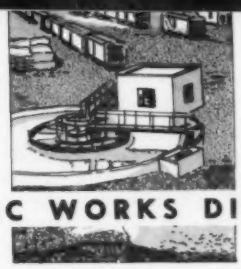


PUBLIC WORKS DIGESTS

Prepared by
CLAYTON H. BILLINGS
Associate Editor

THE INDUSTRIAL WASTE DIGEST

Radioactive Laundry Wastes

To determine the possibility of using conventional biological processes for the treatment of laundry wastes containing low concentrations of radioactive materials, New York University studied a waste composed of citric and nitric acid rinse waters with a pH range of 3 to 5; BOD, 200 to 800 mg/l; and Beta radioactivity from mixed fission products, from 3 to 180 disintegrations per min. per ml. Ammonium hydroxide and trisodium phosphate were added as nutrients. The wastes were treated on laboratory-scale trickling filters under a wide range of loading and recirculation rates. Under any particular loading condition, the radioactivity of the sludge produced increased gradually and finally leveled off at a relatively constant value. The final level in the sludge was about 200 times that of the waste being fed. While the most heavily loaded filters removed more total activity than the lightly loaded ones they also produced proportionately more sludge. These experiments showed that about 80 to 90 percent of the mixed fission product activity could be removed from radioactive laundry waste at loading rates which also produced a BOD removal of over 90 percent.

"Treatment of Radioactive Laundry Wastes." By W. E. Dobbins, New York U. PUBLIC WORKS, December, 1957.

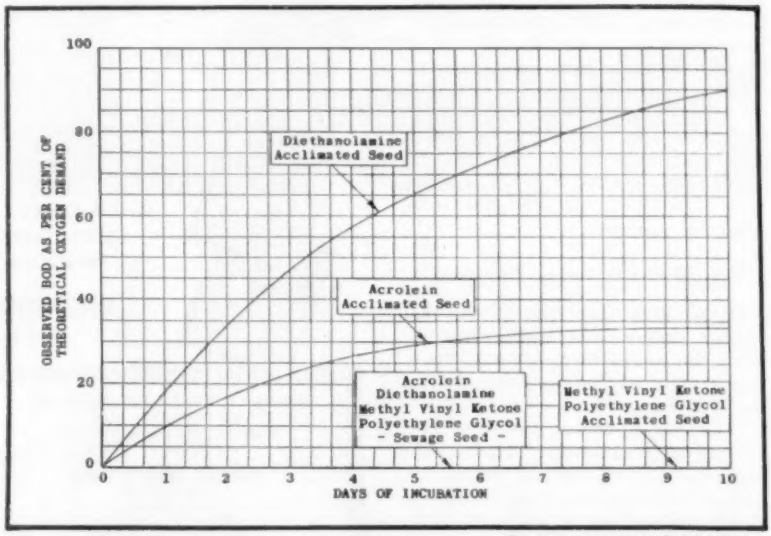
Evaluating BOD Tests For Synthetic Chemicals

The biochemical reactions that lead to oxidation of complex organic material are catalyzed by an enzyme system developed by microorganisms. Nature has provided these organisms with the ability to modify their metabolism to utilize most organic substances to adapt enzyme systems to the new food source. Early attempts by the Union Carbide Chemicals Co. to analyze pollution problems arising from the operation of their South Charleston plant pointed up the inadequacy of the standard BOD test to evaluate an industrial waste effluent, even when the incubation periods were extended to 50 days. Later, the use of the effluent from a laboratory trickling filter to seed BOD determinations gave better results. This led to studies to determine (a) acclimation procedures, (b) toxicity levels, and (c) the BOD of pure synthetic compounds. A long-term BOD-time curve provides the only real means of interpreting BOD data, and an analyst can judge usually from the first curve whether the seed has been adequate. An acclimated seed may classify results in cases of a lag in BOD development for synthetic chemicals. A pure compound can be assumed to be biochemically inert if it develops no BOD and exerts no toxicity. For mixtures, a waste effluent cannot be judged biochemically inert for failure to develop a BOD, because one toxic component may prevent utilization. Once the toxicity — acclimation relationships of a waste are understood, the analyst can tailor the BOD determination to the waste and make it a useful method to evaluate the treatment and disposal problem.

"Biochemical Oxygen Demand of Organic Chemicals." By A. C. E. Oberton and V. T. Stack, Jr., Union Carbide Chemicals Co. *Sewage and Industrial Wastes*, November, 1957.

Chemical Treatment Of Industrial Wastes

The ultimate operation cost of chemical treatment of an industrial waste depends on means available within a plant for use and application of the chemicals, among several factors. This aspect of lime, chlorine, sulfur dioxide, and ozone are discussed. Cheapness of an available lime may not be the controlling economic factor in its use. The suitability characteristics, the storage capacity required, and purchase costs must be balanced. Various types of lime have varying sludge producing qualities which affect sludge disposal problems and costs. The valency or basicity of lime is a factor for consideration in selection of the chemical used. A careful study of waste concentrations and the periodicity of the discharge of wastes should be undertaken where chlorine use is indicated. By means of holding tanks with ca-



Courtesy Sewage & Industrial Wastes

● **COMPOUNDS seeded by acclimated microorganisms classified by BOD development.**

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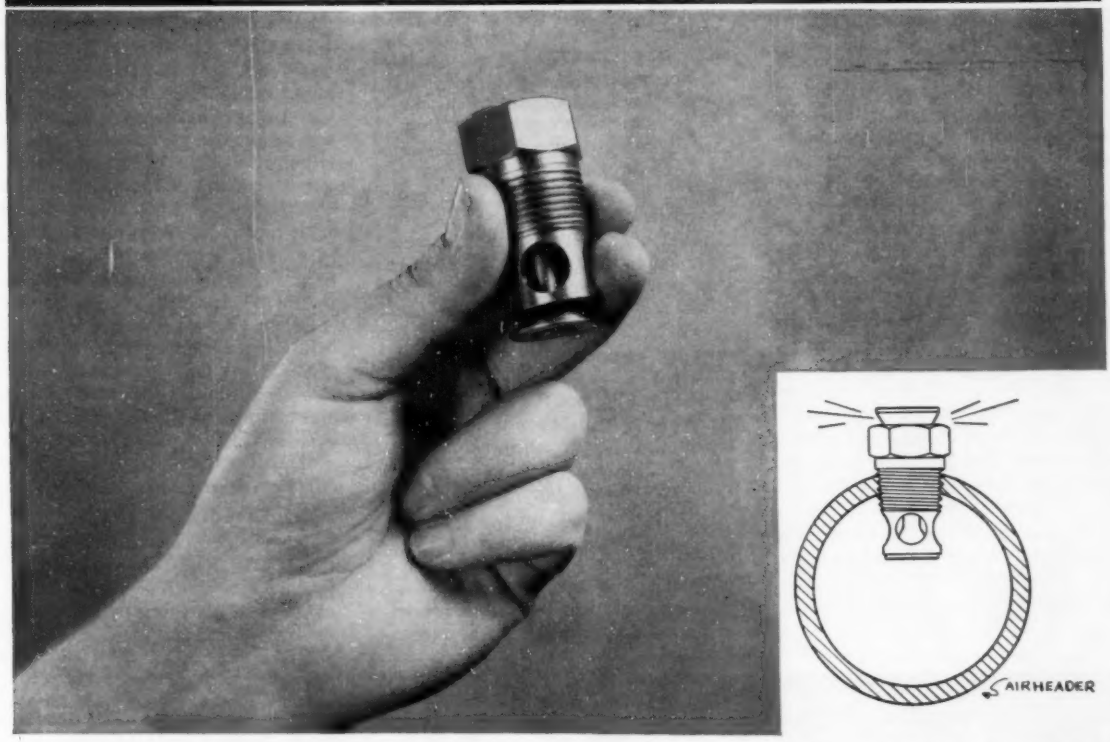

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pacities sufficient to handle the maximum waste discharge contemplated, with pumping facilities to permit alternate use of the tanks, the waste concentration and outflow can be equalized for economical dosages of chlorine. The use of "metered ozone," where the equipment manufacturer installs, maintains, and operates the plant for a fixed fee, is to be applied for the reduction of cyanide in one plant under construction. Sulfur dioxide is easily handled and is available in ton cylinders. As in the case of chlorine, economies can be effected by judicious use of holding tanks for equalization of flow in sulfur dioxide treatment of hexavalent chromium in plating wastes. To treat wastes as they leave the plant entails constant checking of volume and concentration to coordinate chemical application with the need. This requires skilled attention and a large staff. A study of the economics of operation for each case will determine the most logical operating period for the waste treatment—8, 16, or 24 hrs.

"Use and Handling of Chemicals in Industrial Waste Treatment." By E. B. Besselievre, K and H Engineering Co. *Sewage and Industrial Wastes*, November, 1957.

Pickle Liquor Conditions Sewage Sludge

A failing storm and sanitary sewer interceptor which resulted in settling of road pavement in Dearborn, Mich., brought to light the presence of acid wastes in the sewer system. Subsequent sampling and other investigations led to the conclusion that the wastes originated from a local steel mill. Automatic flow and pH monitoring equipment was installed to establish liability of the company. Further investigations indicated the pickle liquor functioned satisfactorily as a sludge conditioner at the city sewage treatment plant. Accordingly, an agreement was reached between the city and industry, whereby the industry would truck its pickle liquor to the sewage treatment plant without charge.

"Pickle Liquor Trucked to Plant for Free Sludge Conditioning." By Michael A. Groen, Supt. of Sewage Treatment, Dearborn. *Wastes Engineering*, November, 1957.

Trickling Filters and Tannery Wastes

Deterioration of treatment afforded by a trickling filter sewage treatment plant was found to be caused primarily by tannery wastes interfering with settling and producing a lime coating on the trickling filter media. Experimentation with neutralizing the waste, showed that carbon dioxide from simulated flue gas could satisfactorily reduce the pH and effect removal of carbonates, sulfides and some BOD. Warburg runs indicated that maximum oxygen uptake occurred when the pH was reduced to 8.9. A pilot-plant trickling filter demonstrated that 90 percent BOD reduction could be obtained, before the waste is mixed with sewage, if the liquid load of the raw mixture is 4.4 mgad or 14 to 18 mgad total. Under these conditions the BOD loading would be about 3800 lbs. per acre foot.

"Biological Treatment of Tannery Wastes." By J. A. McCarthy and B. L. Rosenthal, Lawrence Experiment Station. PUBLIC WORKS, December, 1957.

Oil Refinery Waste Treatment

The problem of disposal of waste at Rock Island's refinery is unusual in that the plant is located atop a water shed and waste water flows through farmland and residential

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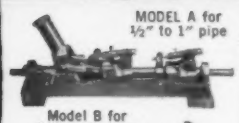

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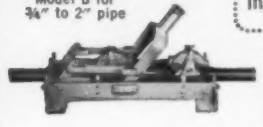

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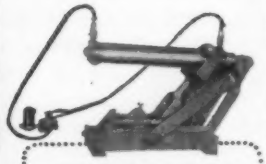

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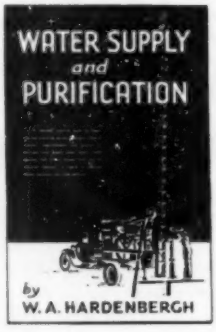

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areas before it picks up dilution. Originally, the refinery used a two-stage API separator for waste treatment, followed by a spray tower. A secondary treatment unit, consisting of an "Accelator" was constructed in 1948 and 1949, to remove sulfides and reduce the oil content. A lagoon was built to level out upsets anticipated. Lime and iron sulfate were originally used for pH control and coagulation, but because of ferric ion coloration of the effluent, it was decided to switch to aluminum sulfate for coagulation. Additional aeration was found to be required to aid sulfide removal. The waste entering the "Accelator" has an approximate oil content of 450 ppm and sulfide, 11.8. These values are reduced to 23 ppm and 4.4, respectively. The BOD reduction is from 145 ppm to 85 ppm. Phenols are unchanged in the "Accelator," but are reduced from 40 to 2.5 by aeration and lagooning. An Oliver filter was later installed for dewatering sludge from the "Accelator."

"Oil Refinery Waste Treatment." By C. O. Anderson, Rock Island Refinery Corp. *Industrial Wastes,* November-December, 1957.

Re-Use of Water By Industries

Industrial plants in the Southwest are aware of the economic benefits of conservation of water, intra-plant re-use of waste water, and pollution abatement. Re-use of waste water is far advanced in Texas plants. Within a few years it will be conventional practice to re-use waste water to such an extent that the salt concentration of refinery effluents will necessitate devising special means for disposal. Indirect re-use (use from streams) is rare in Texas because there are few streams capable of dilution and self-purification. Direct inter-plant re-use is seldom feasible, because of economics and relations between industries. It does seem possible, however, that biological treatment of effluents and sale of them to neighboring industries will be realized. Several Texas industries are now using municipal sewage effluents for cooling and boiler make-up, and more are seriously considering it.

"Utilization of Waste Waters." By C. H. Connell, Medical Branch, University of Texas. *Industrial Wastes,* November-December, 1957.

Other Articles

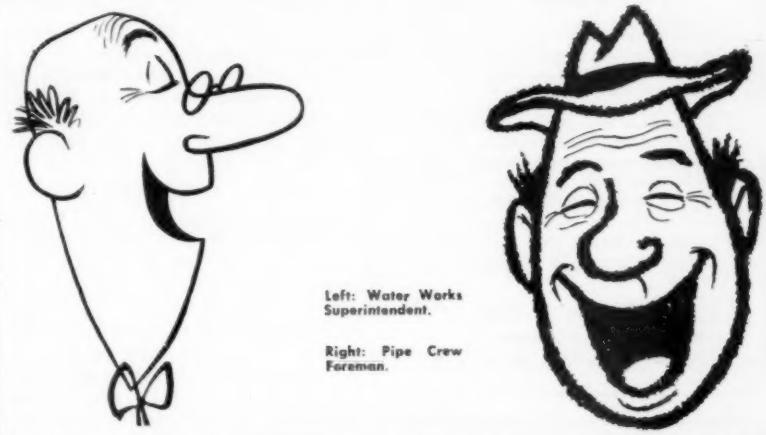
"Water Pollution Abatement Research in the **Steel Industry**." By C. A. Bishop, U. S. Steel Corp. The steel industry is moving along toward pollution abatement in an orderly fashion by installing modern pollution control equipment and is working with regulatory agencies on river recovery studies. Sewage and Industrial Wastes, November, 1957.

"**Waste Pickle Liquor** Disposal." By G. A. Howell, U. S. Steel Corp. Acidity and ferrous iron require treatment before waste disposal to streams. Sewage and Industrial Wastes, November, 1957.

"Industrial Approach to **Air Pollution**." By W. R. Bradley and Arthur Crago, American Cyanamid Co. The approach should include determining if a problem exists, sampling of stacks and air, undertaking public relations, commencing research on control, installing proven equipment, and keeping public and companion industries informed of progress. Industrial Wastes, November—December, 1957.

"Waste Treatment Problems Should Be Tackled **Before the Factory Is Built**." Availability of water, power, and other factors deserve consideration from the standpoint of waste disposal, when a factory is planned. Municipal Engineering, November 1, 1957.

"**Activated Sludge** Treatment for Industrial Wastes." By A. Prescott Folwell. A summary of recent literature reveals that activated sludge treatment is a more versatile treatment method for industrial wastes than was originally thought. Public Works, December.



Left: Water Works Superintendent.

Right: Pipe Crew Foreman.

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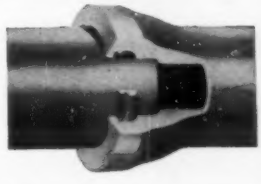

Photograph above shows use of the Fork Tool to push plain end of pipe into the Tyton socket. On sizes 2" and 2¼" to 8", you may also use a crowbar anchored in bottom of trench and pushing against bell-end. Only joint accessory is the Tyton gasket. Eliminates bell holes, reduces pipe line construction time and costs. Joint is flexible and will withstand pressures exceeding those required by standard cast iron pipe specifications. Joint approved by ULI in 4" and larger sizes. Pipe is standard McWane Super DeLavaud, centrifugally cast. Prompt shipment. Write for Tyton Joint folder.

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30-Inch Interceptor Built Beneath Allegheny River

PARTIAL pre-assembly of reinforced concrete pipe sections resulted in substantial time savings during the recent construction of an 1100-foot-long interceptor sewer across the Allegheny River six miles above Pittsburgh's Point. It connects with a trunk sewer which will run under downtown Pittsburgh on its way to the Woods Run treatment plant three miles down the Ohio River.

The 30-inch-diameter sewer was built by Dravo Corporation, Pittsburgh, for the Allegheny County Sanitary Authority sewage disposal system. Laid in a trench as much as 28 feet below the surface of the river, it will carry both sewage and surface water from the Greater Pittsburgh communities of Aspinwall, Sharpsburg, Blaw-Knox, Verona and Montrose.

Because all connections in the interceptor sewer had to be made underwater by a diver, the pipe was pre-assembled in 96-foot sections, consisting of six 16-foot lengths each. About seventy 16-foot sections of the heavy-duty pipe were used in the entire project. Cast by Allegheny Concrete Pipe Associates, the pipe has five-inch thick walls, reinforced with steel mesh, and weighs 620 pounds per foot. Each connection is bolted and the joint sealed with a rubber gasket.

A derrickboat lowered the assembled sections into the trench in the river bed. With a diver on the bottom issuing instructions, the pipe was slowly shifted until its tapered end slipped into the recessed end of the previously laid section and formed a watertight connection against the rubber gasket. After bolting the new joint, the diver walked the length of the pipe, backing off the bolts of the pre-assembled sections to allow for settlement. A pile was then driven at the riverward end of the pipe and a cable from the pile looped around the pipe to hold it in position while a dredge backfilled the trench.

● **WORK fleet places preassembled 96-ft. section of the new interceptor.**

To allow sufficient fall to the trunk sewer, the interceptor is entrenched on a slope ranging from 16 to 28 feet below normal pool. This meant that, because of variations in the river bottom, the trench had to be excavated through from 7 to 26 feet of mud, gravel and clay.

In addition to a number of interceptor lines and diversionary structures, Dravo is constructing a ten-mile stretch of the main trunk sewer, working as much as 100 feet below ground level.

• • •

Field Sampling of Concrete

(*Continued from page* 80)

ft.) + yield in cu. ft. × actual batch weight = weight of each aggregate to use. This usually amounts to 9 to 10 pounds of each of the aggregates, sand, number 3s, and number 4s.

12. Fill the pot a third full of water. Add alternately one part of each of the coarse aggregates and one part of sand until all of the aggregate is inundated in the pot. Jar the pot and rod the aggregate after each addition of sand to eliminate any entrapped air. If the aggregate is dry, let this mixture set for five minutes to permit absorption.

13. Strike off any foam and excess water, clean edge of pot and assemble the meter. The test for the aggregate correction factor is identical with that described for concrete, therefore perform operations 5 through 9. The aggregate correction is the reading on the gage and is usually between 0.1 and 0.8 percent.

NOTE: Ordinarily this factor remains constant (with limestone or gravel coarse aggregate) for the same combination of aggregates. It is essential, therefore, that the aggregate correction factor be determined accurately since any errors made in the factor will be reflected in all air content determinations. Be sure that all air entrapped in the inundated aggregates is removed. The aggregate correction factor shall be checked periodically throughout concreting operations.

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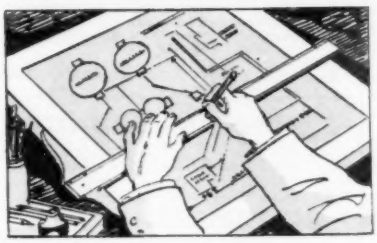

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Two other operations which the Concrete Control Inspector is called upon to perform are the making of cylinders and beams.

Cylinders and Beams

Two test cylinders 6 ins. in diameter and 12 ins. high are made from each 2000 square yards of pavement or base or fraction thereof placed each day from concrete which is being incorporated into the work. Two test cylinders of the same size are made from each 100 cubic yards of each class of concrete or fraction thereof placed each day on structures over 20-ft. span. For structures of 20-ft. span or less the cylinders represent 50 cubic yards of each class of concrete.

The instructions for making the cylinders are as follows:

With the scoop, fill each mold evenly 1/3 full (4 inches) of fresh concrete and rod each mold 25 times with the tamping rod, distributing the strokes evenly over the cross-sectional area of the mold, and completely penetrating the layer of concrete. Next fill the molds 2/3rds full of concrete (8 inches) and rod 25 times as before, making sure that the second layer of concrete is completely penetrated by the rod. The rod should penetrate into, but not through, the previous layer. Finally, fill the mold to over-flowing and rod 25 times as before, then, placing the hands firmly around the mold and pressing downward, quickly rotate the mold through half its circumference, so as to seat the specimen firmly on its base and to insure that the concrete conforms to the shape of the mold. Using the tamping rod or trowel, strike off the excess concrete flush with the top of the mold. This concludes the operation, and there should be no further manipulation of concrete or mold. Specimens shall be made in one continuous operation.

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oratory where the compressive strength of the concrete is determined.

Two or three (depending upon which type of testing machine is used) 6-in. x 6-in. x 40-in. concrete beams, using the same concrete as that which has been placed in the pavement or base, are made for each 2000 square yards of pavement or base, or fraction thereof, placed each day. When it is desired to remove falsework on structures of 10-ft. span or over in less than the minimum specification time, beams as noted above are made from the same concrete as that supported by the falsework.

Instructions for making beams are as follows:

The two (or three) steel beam molds shall be placed on a smooth, clean, level surface which has been lightly oiled to prevent the concrete from sticking. The inside of each mold shall also be oiled in the same manner. The molds shall be clean and free from rust and hardened concrete. With a shovel, fill each mold evenly 1/2 full (3 inches) of concrete representative of that in the batch, then, with the blade of the spading tool held at an angle to the ends of the mold, spade the concrete 20 times at equal intervals from one end of the mold to the other. Then, turning the blade of the spading tool, crossspade 20 times at equal intervals back in the opposite direction to the end of the mold. Then spade entirely around the sides and ends of the mold. Fill the mold to overflowing with concrete and repeat both spading operations as before. Strike off the excess concrete, and trowel the concrete flush with the top of the beam mold.

Beams made from ordinary Portland Cement concrete for pavement or base shall be tested at 3, 5 and 7 days. Beams made from high-early-strength Portland Cement concrete for pavement or base shall be tested at 1, 2, and 3 days.

Beams made to determine when falsework shall be removed shall be tested at the time specified by the Engineer.

The Concrete Control Inspector is responsible for testing the beams to determine the tensile strength of the concrete. Two types of testing machines are used: Cantilever (two beams required) and centerloading (three beams required). When using the cantilever type, the load is applied through a crank and set of gears and recorded on a dynamometer or spring scale with 1000 pounds capacity. The load is applied through a hand wheel and hydraulic support on a center-loading machine

and recorded on a pressure gauge with 8000 pounds capacity.

Cantilever Type Testing Machine. Slide the beam forward from the back end of the machine until the end is 10 inches beyond the center of the breaking edge. Then tighten the bolts just sufficiently to hold the beam firmly in a horizontal position. Next place on top of the beam at the extreme edge the small plate through which the load is to be applied. Attach the dynamometer to the hook at the end of the lever arm. Make sure that the safety clamp is securely fastened. Next attach the lower hook with the opening toward the beam. Take up as much slack as possible by turning down the nut on the vertical screw by hand until it just fits into the square hole in the plate at the bottom, or if equipped with a hinged plate, until that plate will engage the nut. Now apply an initial load of 100 pounds by turning the crank. After the initial load has been applied, the rest of the load shall be applied uniformly at the rate of approximately 160 pounds per minute. The hand on the dial must be watched closely as the load nears the breaking point, because the impact at the break frequently throws the maximum load pointer forward or backward, making accurate reading difficult.

The center-loading type testing machine. Set the beam on two 2-in. x 4-in. blocks and plainly mark off the center of the two-foot span with a straight line running from top to bottom on both sides of the beam. Next place the machine over the beam with the center bearing underneath the beam. The center of the bearing should coincide with the lines marking the center of the two-foot span. Then take up the slack by turning the hand-wheel until the hand on the dial indicates the load is being applied. Extreme care must be taken to turn the wheel slowly as the load goes on very rapidly even with very slow turning of the wheel. Approximately 1400 pounds per minute on this machine are equivalent to 160 pounds per minute on the cantilever type. After the initial indication of load, fasten the lever to the hand-wheel and apply the load uniformly at the rate of 1400 pounds per minute until the break occurs. The hand on the dial must be watched closely as the load nears the breaking point, because the hand usually jumps at fracture. The maximum load pointer cannot be relied on for the breaking load.

A conversion table is provided each Inspector to facilitate the conversion of scale readings to module of rupture.

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Vitrified clay pipe with a glass lining has been developed by American Vitrified Products Co. Amvit Glas-Glaz, is designed for use as sewer connections for home, industrial and municipal sewer lines. It is coated with a glass-like ceramic glaze. The pipe is available in lengths of 4 feet in 4, 6 and 8-in. diameters. Amvit Glas-Glaz pipe can be used with the Amvit joint which is a compression type joint based on the ball and socket principle. For further details write American Vitrified Products Co., Cleveland, Ohio, or circle **No. 1-2** on the reply card.

Pure Resin Pool Surfacing

A water-tight pool surfacing called "Poly-Rock," has been announced by Plant Maintenance. It may be applied by brush, spray or roller to newly constructed pools or those already in service, the latter with proper base preparation. Only two coats are normally required and these may be applied an hour or so apart. In the case of old pools or those in need of repairs, Poly-Rock can be combined with fiber glass, laid right on the job, to completely close off all breaks, patches and cracks. The material can be applied in a glassy-smooth or porcelain-like finish or non-slip for areas around pools, gutters, etc. It is unaffected by chlorine or other water purifying agents. More details from Plant Maintenance, Inc., Cleveland 21, Ohio, or circle **No. 1-3** on the reply card.

Method of Cleaning Sewers

The Flexible Porcupine "for cleaning sewers fast" when the deposits are light, is announced by Flexible Inc. In using the Porcupine for sewer cleaning, it is necessary to "work with the flow" for moving sand or silt. In this case a head of water is built up which jets through the bristles and washes the deposits down the line as they are churned up by the tool. Grease is worked against the flow, so cuttings work toward the operator instead of packing ahead of the tool. For further details write Flexible Inc., Los Angeles 34, Calif., or circle **No. 1-4.**

Davis Backhoe Digs Square Corners

An operator can effectively dig out a corner, then trench from the corner in a direction parallel with the tractor and finally in a perpendicular direction, and without moving the tractor with the Davis backhoe. Features which permit this operation are: Visibility, the seat moves with the boom so that the operator faces his work at all times; versatility, the hydraulic rotary boom swing cylinder gives a smooth, continuous 200 degrees of cushioned operating arc without the use of cables and without changing a pin; and side mounting, three interchangeable mounting points on the frame make it possible to move the entire mast and boom assembly from center to side for flush digging alongside buildings and fences. For more data write Massey-Ferguson Industrial Div., Wichita, Kans., or circle **No. 1-5** on the reply card.

To dig square corners, side-mount backhoe and move tractor perpendicular to trench

High Speed Slurry Pump

A medium-range, high speed slurry pump, known as the type BA, has been introduced by Morris Machine Works for handling suspensions of sand, silt, sludge, lime or chemical process slurries. Built in 1, 1½, 2, 3 and 4-in. sizes, the BA pump is easy to dismantle and reassemble. For further information write to Morris Machine Works, Baldwinsville, N. Y., or circle **No. 1-6** on the reply card.

Case Tractors Have Power Automation

A new principle in farm and industrial tractor engineering, called Case-O-Matic, is announced by J. I. Case. This drive is similar to the automatic drive of the modern automobile. It is a torque converter drive plus a conventional direct drive. The Torque converter automatically adjusts tractor pull-power to the load and direct drive gives maximum travel speed in any gear. There is a wide selection of working

New Case-O-Matic drive automatically adjusts pull-power and speed to load

ranges, with 8 forward ranges in some units. The operator can change from direct drive to torque converter and back with merely the flip of a lever on the steering column while the tractor is standing still or "on the go" under load. For more details write to J. I. Case Co., Racine, Wisc., or circle **No. 1-7** on the reply card.

Survey Marking and Identification Equipment

Surveyor stakes and identification caps are announced by Bathey Mfg. Co. Solid, corrosion-resistant brass caps are cadmium plated to preserve appearance. Permanent property markers come in standard lengths of 3, 18, 24, 36 and 48 ins. For further information write Bathey Mfg. Co., 100 South Mill St., Plymouth, Mich., or circle **No. 1-8** on the reply card.

Sweeper Available For "Michigan" Tractor Shovels

A sweeper attachment for the "Michigan" line of tractor shovels is announced by Clark-Wilcox Co. The sweeper has a simple design that permits speedy hook-up on the bucket and comes in sweeping widths from 50 inches to 100 inches. The bucket is placed on the ground; the operator drives forward, flips a hydraulic control and the broom

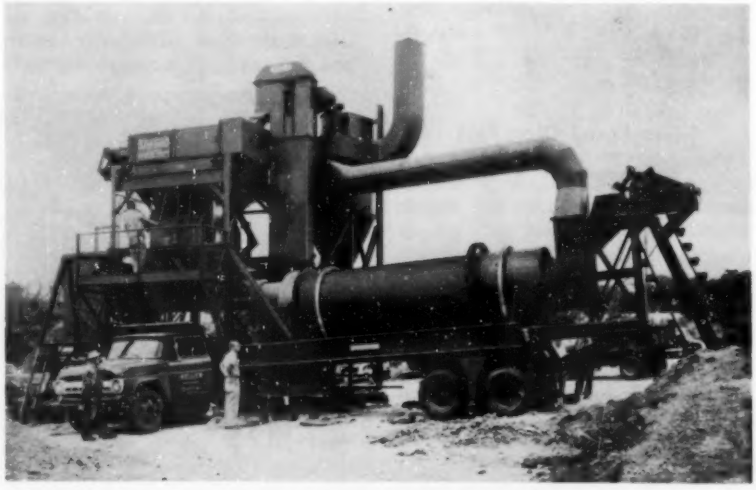
rotates and sweeps refuse and dirt into the bucket for a clean swath. Lack of overhang at the sides makes possible cleaning close to curbs and obstructions. After the area has been swept, the operator merely raises the bucket and broom without spilling the material. When the load is over the haul truck, the operator tilts the bucket and the material spills out. Broom and bucket do not interfere with each other, permitting both sweeping and loading. If desired, the operator can reverse the broom rotation. Broom bristles, made of Palmyra fibre, are attached to the core by steel cable. Easy manual adjustments allow the operator to compensate for wear. The entire sweeping attachment weighs about 1,000 lbs. For further information write to Sweeper Division, Clark-Wilcox Co., 118 Western Avenue, Boston 34, Mass., or circle **No. 1-9** on the reply card.

Gradeline Adjustable Survey Stake

A metal grade stake that can be driven into the subgrade by hand or mechanical means is announced by George E. Long Co. The line and station arm is placed at the intersection of line and station and locked in position by means of the bolt on the clamp. Grade at this point is then shown at the top of the offset arm and similarly locked in position. The offset is provided to cover a situation where the grade may fall in the other clamp. The stake is normally furnished 30 inches in length with a line arm 8 inches long. For further details write George E. Long Co., 16041 33rd Ave. N.E., Seattle 55, Wash., or circle **No. 1-10.**

High-Capacity Portable Asphalt Plant

Standard Steel Corp. is now in full production of its new TM one-ton capacity trailer-mounted Mobile Mixer. Completely self-contained on a single trailer frame, this new type asphalt plant is especially designed for on-the-job mixing. The TM Mobile Mixer can be erected and made ready to produce asphalt mix in a few hours. Special features include a built-in power-erecting device which raises the entire mixing and gradation section from transport to operating position, positive weigh control with an aggregate weigh hopper and an asphalt bucket suspended on springless dial scales, and simplified push button controls to reduce operator fatigue. Write for complete details to Standard Steel Corp., 5001 South Boyle Ave., Los Angeles 58, Calif., or circle **No. 1-11** on the reply card.



Plant is designed for on-the-job mixing in rural areas and hard-to-reach locations

Concrete tester being used on jobsite

Portable Concrete Cylinder Tester

The Forney Model FT-25 concrete cylinder tester can be used on any construction project. It can be easily transported from one jobsite to another. It has a capacity of 125 tons and will test 6″ x 12″ cylinders. With accessories the unit can test 2″ x 2″ cubes, 6″ x 6″ cubes, beams up to 40″ long and blocks up to 8″ x 8″ x 16″. The manually operated pump is a two-speed concentric unit and can accomplish the initial loading at high speed and then automatically shifts to slow speed for test loading. For further details write Forney's Inc., Tester Div., P. O. Box 310, New Castle, Pa., or circle **No. 1-12** on the reply card.

Heavy Duty Sump and Process Pumps

A new and complete line of heavy duty vertical centrifugal pumps for sump and process service has been introduced by Goulds Pumps. These single and duplex units, both wet and dry pit type, have capacities to 1080 gpm with heads to 290 ft. for pit depths up to 20 feet. Basic design of these sump pumps provides users with custom built pumps through usage of standardized parts. The pumping unit may be adapted in the field for changed pit depths or pump ratings simply by installing new and standardized parts. Vapor proof construction can be supplied on all units with all possible points of leakage of vapor or fumes sealed. Pump assembly, including the cover plate, is a complete unit. With single pump, submerged or wet pit type units, the pump is placed directly into the sump which contains the liquid to be pumped. Liquid level controls can be furnished to start and stop the pump automatically. With duplex pumps, submerged or wet pit type units, two pumps are mounted on the pit cover. Ordinarily these units are furnished with an alternator which controls both pumps automatically. For further information write to Goulds Pumps, Inc., 38 Black Brook, Seneca Falls, N. Y., or circle **No. 1-13** on the reply card.

Dual Purpose Roller-Compactor

Deep penetration vibratory compaction and static-weight surface rolling can be accomplished in a single operation by the Austin-Western roller-compactor. When not needed as a vibratory compactor, the machine serves as a regular three-wheel, ten to twelve-ton variable weight roller. The vibratory portion of the machine is a self-contained unit which can be used with Austin-Western Model 102 ten to twelve-ton variable weight rollers. The vibratory unit consists of a three-shoe vibrator assembly, an independent hydraulic system and a separate 61 hp gasoline engine. Vibratory compaction is accomplished by two steel shoes 27⅞ inches wide

Unit compacting stone base ten inches thick on a highway construction job

and 25¼ inches long, and a center shoe 25½ inches wide by 25¼ inches long, actuated by hydraulic pump-gears which operate in unison to produce a straight line vibration across the full 82¾-in. length of the vibrator. Each shoe weighs 450 pounds and vibrates through a vertical distance of ¼-inch at the rate of 2100 to 2200 times a minute. For complete specifications write Austin-Western, 601 Farnsworth Ave., Aurora, Ill., or circle **No. 1-14** on the reply card.

Spreader For Mounting On Dump-Trucks

A Shunk-Torwel spreader for dump-truck mounting has been announced by Shunk Mfg. Co. The spreader is designed for sanding, cindering or salting for winter ice control work and for spreading stone, chips, calcium chloride, lime

Spreaders are of twin-spinner design

and other materials to meet a wide variety of applications. Mounting or dismounting can be accomplished approximately in the same amount of time normally required for a tire change. The machine is of twin-spinner design, and the spinner shafts may be adjusted to the most efficient length for any given dump truck body. Other features include one-man operation, from the cab; a wide spread area, which can cover a three-lane highway in a single pass; arrangements for spreading to one side without windrowing; even spread density; and heavy-duty construction throughout. The spreader is available in capacities of five, six and seven cubic yards, and larger capacities may be specified on order. For further information write Shunk Mfg. Co., Bucyrus, O., or circle **No. 1-15** on the reply card.

Incinerator Dump Body

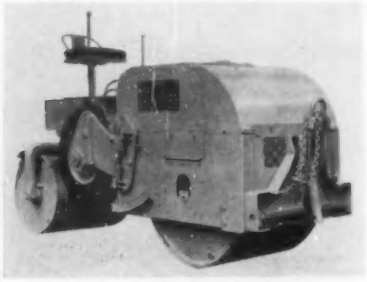
An incinerator dump body has been built by Daybrook Hydraulic Division. The dump body capacity is 15 cubic yards and construction is all welded steel of heavy gauge for continuous 24-hour operation. A special heat-resistant paint is used as hot ashes are dumped directly from the incinerator into the body. Ashes are wet down, therefore the body has a special watertight tailgate assembly air-operated by three air cylinders off the main line. The body has leakproof drain ports. For further information write to Daybrook Hydraulic Division, L. A. Young Spring & Wire Corporation, Bowling Green, Ohio, or circle **No. 1-16** on the reply card.

Reflective Glass Beads

A reflective glass bead for application to traffic signs, street name signs and license plates is introduced by Flex-O-Lite. The improved glass bead makes possible white and yellow signs with greater reflectivity and message legibility. Applied by conventional methods and "permanized" with Flex-O-Lite's new Stormcote protective covering agent, signs are weather, water, dirt and wear resistant, providing day and night reflectivity. Available in all standard sizes for application to traffic signs, the new #831 Bead is also made in "extra-fine" grade for street name signs and license plates. Full details from the Flex-O-Lite Mfg. Corp., 8301 Flex-O-Lite Drive, P. O. Box 3066 (Affton Branch), St. Louis 23, Mo., or circle **No. 1-17** on the reply card.

4-6 Ton Tandem Roller with Fold-Away Wheels

A new 4-6 ton tandem roller with hydraulically operated transporting wheels and an exclusive "fold away" feature has been announced by Buffalo-Springfield. The Model KT-8 features an entirely new concept in the retractability of towing wheels. When the wheels are not in use, they are raised hydraulically and folded into the sides of the main frame. This eliminates the overhang of transporting wheels, provides greatly increased operator visibility and holds the over-all operating width of the machine to an absolute minimum. It can be worked adjacent to obstructions, high curbs and forms without removing the wheels. It has torque converter drive, which automatically matches power to variations in grades and materials and permits infinitely variable travel speeds from 0.5 to 5.3 mph in either direction. In addition to the 4-6 ton model, Buffalo-Springfield also offers a 3-5 ton tandem roller. This machine is of the same basic design as the Model KT-8 except it does not include the hydraulically operated towing-wheel arrangement. For full details write Buffalo-Springfield Roller Co., Div. of Koehring Co., Springfield, O., or circle **No. 1-18** on the reply card.



Roller can be worked close to curbs and forms without removing the wheels

Main-Line Meter With Magnetic Propeller Drive

Sparling's new direct mounted Indicator-Totalizer is a standard feature

A new main-line meter, incorporating a powerful radial magnet, molded as an integral part of the propeller hub, has been developed by the Sparling Meter Co. A companion magnet on the drive shaft of the meter permits motion to be transmitted to a sealed transmission from the propeller to the register. This sealed mechanism reduces friction and maintenance. This direct mounted indicator-totalizer is a standard feature of the Sparling Masterflo meter. The unit is available in 4 to 24-in. sizes and in working pressures, either standard 150 or 250 psi. More information from Sparling Meter Co., 225 North Temple City Blvd., El Monte, Calif., or circle **No. 1-19** on the reply card.

Bituminous Mixing Plant

The H-15, announced by Cedarapids, is a stack-up, tower-type bituminous mixing plant consisting of a hot elevator, screen and bin section, batcher and mixer section, bitumen pump, jacketed bitumen piping and valve, stairway, platform, controls and drives. The plant is extremely easy to erect since the sections are self-contained units. The H-15 is offered as a portable or stationary plant with a choice of combustion engine or electric motor drive. All gates and valves are operated manually through mechanical linkage, except the discharge gate which has a manually controlled hydraulic cylinder. For detailed specifications write to Iowa Manufacturing Co., Cedar Rapids, Ia., or circle **No. 1-20** on the reply card.

New "Full-Color" Safe-T-Cones

A brilliant color Safe-T-Cone traffic guide is announced by Radiator Specialty Co. The color is "Kneaded" right into the basic components of the traffic markers, making them "full-color" for life, without peeling or cracking of paint and they never need repainting. Traffic film, dirt and grime can be washed off with soap and water. Known as Poly-Cones, these markers are specially molded of poly-vinyl chloride, a tough, plastic-type substance that remains pliable. They will not crack or tear even when run over by the heaviest trucks or buses. They are available either all yellow or with brilliant fluorescent color for extra visibility. For full details write Radiator Specialty Co., Charlotte, N. C., or circle **No. 1-21.**

Rynal Plastic Filament Street Sweeper Pick-Up Brooms

Rynal Corp. has developed a means of applying plastic filaments to street sweeper pick-up brooms. Rynal filaments are automatically bonded in steel channels, forming sturdy broom strips of uniform fill. The strips are delivered in neat cardboard cartons, ready to be locked on the core. The unique strip method permits easy replacement of the whole broom when worn out (without removing the core from the sweeper)—or spot repairs can be readily made in case of accident. Coiling equipment is eliminated and storage space is minimized. No changes are required in your present equipment and prewetting operations are eliminated. The brooms will not support combustion; rodents will not chew them; moisture, bacteria or fungus will not attack them. Brooms are available in three weights: 20 strips for light sweeping, 24 strips for normal sweeping and 30 strips for extra heavy sweeping. For full details write Rynal Corp., 114 St. Joseph Street, Arcadia, Calif., or circle **No. 1-22** on the reply card.

Moisture and bacteria will not attack the new Rynal plastic filament brooms

Mix-Elevators For Concrete Guns

Two new Airplaco mix-elevators have just been announced by the Air Placement Equipment Co. They are the Model 600 and the 610 mix-elevators for high production and continuous aggregate proportioning, mixing, elevating and screening for all concrete guns. The two units are basically the same except that the Model 610 incorporates a built-in aggregate dryer. The drying apparatus includes a 750,000 BTU propane or LP gas burner, with the necessary duct work directing the hot air blast into the sand bin and along the length of the mixing trough. It is this hot air that tempers the moisture content of the sand. The units can be operated at any desired rate up to 12 cubic yards per hour. For more data write Air Placement Equipment Co., 1009 West 24th St., Kansas City Mo., or circle **No. 1-23** on the reply card.

Sieve Shaker For Aggregate Testing

Shaker and sieves for aggregate tests

The Dynamic sieve shaker made by Soiltest, can be used for all types of field, laboratory and production sieving or grading operations on materials such as soils, sand, gravel, aggregates and similar granular or powdery substances. The shaking pattern involves the sieve platform being rotated in a small circular arc at the same time that it is being swayed in a vertical arc. An impact is imparted to the platform six times per revolution. The shaker motion continuously moves and redistributes the particles being analyzed over the sieve meshes. The tapping action assures proper separation of all materials and a fast flow of the materials through the sieve meshes. This light weight shaker is available in either hand operated or motorized models and in sizes for 8-in. or 12-in. diameter sieves. For more information write Soiltest Inc., 4711 W. North Ave., Chicago, Ill., or circle **No. 1-24** on the reply card.

Two cubic yard Tractoloader with long booms loading aggregate into a railroad car

TL-20D Tractoloader With Long Booms

Dumping clearances of 13 ft. 10 ins. under the hinge pin, and 11 ft. 4 ins. under bucket cutting edge, are now obtainable on the 2-cubic yard TL-20D Tractoloader through the use of a special long boom arrangement. With this long boom the unit has a minimum reach of 3 ft. 3 ins. at maximum height and at the 9-ft. dumping clearance the minimum reach is 4-ft. 6-ins. It is recommended for use in materials weighing up to 2700 pounds per cubic yard. Other features include single lever speed and direction control of the power shift transmission, torque converter, planetary axles pin-connected to the frame, power steering, power brakes and 24 volt electrical system. For further details write Tractomotive Corp., Deerfield, Ill., or circle **No. 1-25** on the reply card.

General Purpose End Suction Pumps

End suction type BC general purpose pumps are announced by Aurora Pump. They come in close-coupled horizontal, flange mounted vertical, base mounted vertical and pedestal mounted horizontal units. The range of sizes are ¼-hp to 40-hp at 3,500 rpm; and ¼-hp to 20-hp at 1,750 rpm. They can be used in circulating, coolant, cooling towers, condensate return, booster, hot water, tank mounted applications, swimming pools, filters and sprinklers. These pumps have steep sloping characteristics with constantly rising head to shut-off; low impeller velocities for smooth, quiet operation; and where necessary to reduce axial thrust, bearing load is kept to a minimum by means of balancing rings. For further data write to Aurora Pump Division, The New York Air Brake Co., 89 Loucks St., Aurora, Ill., or circle **No. 1-26** on the reply card.

All Purpose Roller

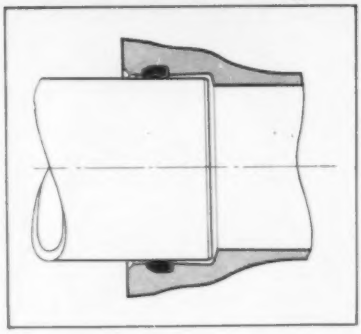
The Poweroll, announced by Power Development Co., is designed for black top work, sidewalks, driveways, parking lots and compacting roadways. It is driven by a 3 hp engine and weighs 1260 lbs. when filled with water. The unit can be transported by a pickup truck from job to job. For more details write Power Development Co., Inc., Mills Road, Avon, Ohio, or circle **No. 1-27** on the reply card.

One-half ton Poweroll with a 17½ gal. water tank working on a street project

Altite Rubber Gasket

The Altite joint was developed by Alabama Pipe Co. It is simple and easily assembled and consists of only one accessory, a rubber gasket. The gasket consists of a soft rubber O-ring with hard rubber tips made integrally on opposite sides of the O-ring. The symmetrical shape allows the gasket to be placed in the gasket seat without any concern for installing backwards. Altite joint pipe is furnished in nominal 18-ft. lengths and a gasket is furnished with each joint of pipe. For further data write Alabama Pipe Co., P. O. Box 791, Anniston, Ala., or circle **No. 1-28** on the reply card.

Joint For Water Pipe

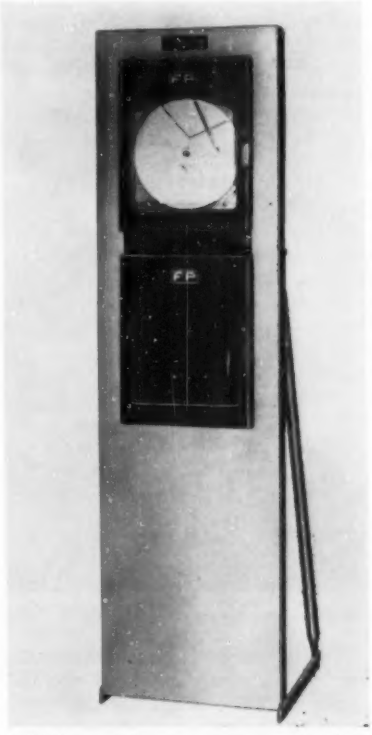


Either mechanical joint or all bell caulked type fittings may be used with Altite joint pipe. Assembly can be learned quickly by inexperienced men.

• • •

Residual Chlorine Analyzer Gives Continuous Measurement

A residual chlorine analyzer (Model 17A1100) that provides continuous automatic measurement of free, combined, or total residual chlorine in water or sewage is announced by Fischer & Porter Co. Accurate within plus or minus 1 percent of the maximum range, the analyzer is essentially a double light beam filter photometer. The device is supplied in two standard ranges:



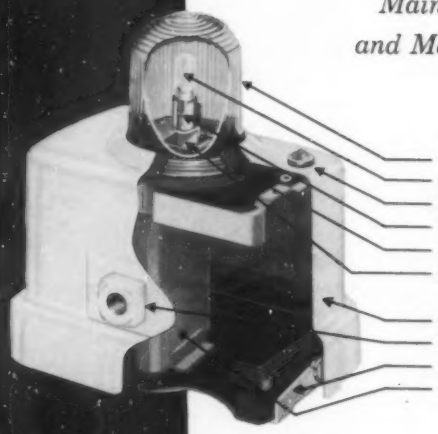
Chlorine analyzer measures the free, combined, or total residual chlorine

0 to 1 ppm, or 0 to 10 ppm. Used in combination with a Fischer & Porter Model 1102 recorder, the analyzer can also be used with an electric, electronic or pneumatic controller or transmitter for automatic control or for remote recording. For more information write Fischer & Porter, 465 Jacksonville Road, Hatboro, Pa. or circle **No. 1-29** on the reply card.

NEO-FLASHER . . . announces

NEO-TRANSISTOR

. . . the light of Minimum Maintenance and Maximum Brilliance



A. Unbreakable 360° Lens
B. Brilliant Incandescent Bulb
C. Watertight Rotary Switch
D. Removable Bulb Socket
E. Watertight Lens Gasket
F. Transistor Circuit Mounted on Metal Plate
G. Watertight Seamless Case
H. Locknut Welded to Case
I. Watertight Gasketed Bottom
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Project Manager on foreign road construction to direct the foreign road construction program (running concurrently in several countries) with a long established major contractor engaged in a broad construction program on a world-wide basis. The position requires an able administrative engineer with several years experience with a major construction contractor—preferably in the road building field. Some foreign travel necessary. Headquarters in New York City. Starting salary is about $15,000. No fee. No reference checks without the consent of the candidate. Identities protected. Write A. H. Payne, Executive Service Corporation, Inc., 19 West 44th Street, New York 36, N. Y.

CORRECTION

In the article on "Corrosion Studies" by Professor Werner Stumm of Harvard University, appearing in December, pages 78-80, the labels on the two curves in Figure 3 were transposed. The curve with the higher corrosion rate should have been assigned a pH of 8.0 and the curve with the lower corrosion rate a pH of 6.9.

Purdue Industrial Waste Conference

The 13th Purdue Industrial Waste Conference will be held May 5 to 7. Don E. Bloodgood, Professor of Sanitary Engineering, Purdue University, Lafayette, Ind., will supply detailed information.

NEWS OF ENGINEERS

LEO A. PORTER has been made Bridge Engineer for Capitol Engineering Corp., and will be located at Dillsburg, Pa. For eleven years starting in 1945, Mr. Porter was Chief Bridge Engineer for the Pennsylvania Dep't. of Highways.

GEORGE C. BUNKER, long-time consulting engineer, Apartado 51, Panama, R. de P., has announced his retirement. He has had a distinguished career and contributed much to sanitary engineering over the years.

EARL P. WILSEY, principal and senior partner in the consulting engineering firm of Wilsey & Ham, Millbrae, Calif., died Nov. 15. The work of the firm will be carried on by Lee E. Ham and Charles T. Blair, remaining principals.

CLASSIFIED ADVERTISING AND JOB OPPORTUNITIES

SALES REPRESENTATIVES AND MANUFACTURERS AGENTS WANTED

National manufacturer of building maintenance, waterproofing and paint specialties has openings for sales representatives experienced calling on city engineers, architects and maintenance personnel. Our products are non-competitive, heavy repeat volume sold direct to Federal, State, Municipal and industrial projects. Exceptionally attractive commission arrangements with full credit on reorders. Write stating experience, territory serviced and any lines presently handled.

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WANTED

PUBLIC WORKS ADMINISTRATOR

Town of Billerica, Mass., is seeking a Public Works Administrator. Located 20 miles north of Boston. Responsibilities will include charge of Water, Highways, Trees, Moths, Parks, Equipment and Office Staff. Degree in Civil Engineering required. Salary $7,500 to $9,000.

Submit applications to:

Board of Selectmen
Billerica
Massachusetts

ASSISTANT SALES MANAGER

Nationally known manufacturer has opening for Civil Engineer or equivalent, who has had heavy sales experience contacting road building contractors and highway officials. Age 35-45. Will train to succeed present sales manager who is approaching retirement age.

Please submit resume giving complete employment history, education, age and salary requirements.

Our sales personnel are familiar with this ad. Replies held confidential.

Write to:
BOX 1-1
Care of Public Works Magazine

TRANSIT DIVISION CHIEF

CITY OF PHILADELPHIA—Attractive administrative professional engineering position available for qualified man capable of handling responsibility involved in planning, directing, and coordinating transit design, construction, and operation. Includes development of long-range policies and programs for extensive improvements and extensions to rapid transit systems.

Engineering degree and ten years of progressively responsible experience in planning, design, and construction of transit facilities, including experience in responsible administrative capacity, experience in the operation of transit system, and experience in supervision of construction contracts is desirable. Any combination of experience and training approximating this will be considered.

Send complete resume and salary requirements. All replies confidential.

Commissioner S. B. Regalbuto
Dept. of Public Property
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Philadelphia 7, Pa.

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PUBLIC WORKS JOURNAL CORP.

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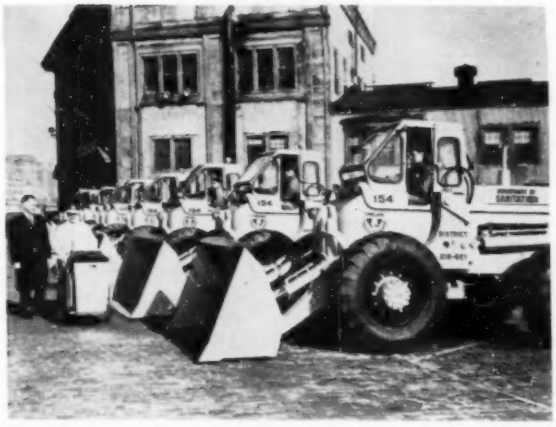


In contrast to the small, slow-moving double can-carrier, of 8 cubic feet capacity shown at left is the fleet of new Trojan tractor shovels lined up for inspection by New York City's Commissioner of Sanitation Paul Screvane. These 4-wheel drive tractor shovels are used in snow removal and ice control in winter, general street clean-up in all the year. Contractors Machinery Div. of Yale & Towne make them.

Playing a major role in the development of an operators' school to meet an unprecedented demand for heavy equipment operators required to meet the stepped-up highway-building program is this Austin-Western Super 99 Six-wheel drive-and-steer Tandem Power Grader. This outdoor school is at Weiser, Idaho. Courses cover from 6 to 8 weeks.

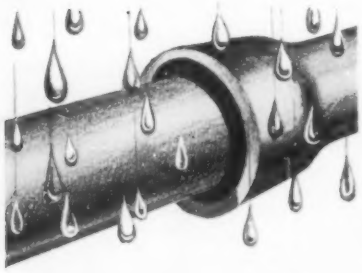
Had we had this Bendix electronic digital computer when we were in school our math. marks would have been vastly better! Harley, Ellington and Day, Inc., Detroit architects and engineers, estimate its use in their offices as resulting in a 30 to 1 saving in time and a 15 to 1 saving in the cost.

Four new 16 cubic yard capacity Power Packer refuse collection bodies, manufactured by Daybrook Hydraulic Division, L. A. Young Spring and Wire Corporation, Bowling Green, Ohio, lined up ready to hit the line in the clean-up campaign in Springfield, Ohio. All are driver-controlled.

You can't go wrong on the new Sunshine State Parkway in Florida—not with these feature span signs by Pfaff and Kendall, of New Jersey, on the job overhead. Being made entirely of aluminum, they will not rust or need painting.

Atlas JC-60®

STOPS INFILTRATION



. . . reduces pumping costs!

Infiltration of soil water into your sewage system greatly increases pumping and operation costs at the disposal plant. JC-60, a plastic-base sewer jointing compound, stops infiltration by adhering tenaciously to properly primed pipe.

This superior Atlas compound gives adhesion values of over 300 p.s.i. guaranteeing to you permanent bottle-tight joints. You are assured of lower pumping costs and long term service, with a minimum of costly repairs, when you specify JC-60.

Get the complete facts; write for Bulletin M20-3.

ATLAS MINERAL PRODUCTS COMPANY
MERTZTOWN, PENNSYLVANIA

by Arthur K. Akers

★ A HAPPY NEW YEAR and a prosperous one to all of you!

★ MYRON KITAIF moves up from advertising manager to manager of Blackburn-Smith Mfg. Co. Division, Condenser Service and Engineering Co., Hoboken, N. J.

★ BARTLETT G. BRETZ is promoted to assistant western sales manager, United States Pipe and Foundry Co. at Chicago. He was formerly at Kansas City.

★ AMERICAN VITRIFIED PRODUCTS CO., Cleveland, has acquired the clay pipe plants of the Whitehall Sewer Pipe Co. in Whitehall, Ill., formerly operated by the Laclede-Christy Division of H. K. Porter Co.

★ "THE ROAD AHEAD" is a new color motion picture released by Caterpillar Tractor Co. to explain the U. S. highway program to the public. Contact Caterpillar's Advertising Division in Peoria or any "Cat" dealer for showing to your group or organization.

★ JOHN W. SPOOR is newly-appointed vice president and director of sales, Seaman-Andwall Corporation Division of American-Marietta Co. W. D. Murphy and Jack E. Bohrman remain as other vice presidents.

Mr. Diller

★ ROBERT H. DILLER is the new advertising manager of Austin-Western Division, Baldwin-Lima-Hamilton Corporation. Diller joined Austin-Western, at Aurora, Ill., in 1951 as assistant to Howard F. Barrows, recently retired as advertising and sales promotion manager. Here is the more unique case of "home town boy makes good"—in his home town. Diller was born in Aurora, and is an alumnus of Northwestern Medill School of Journalism.

★ BLAW-KNOX CO. announces appointment of Wendell F. Simmons as a regional vice president in the New York-Philadelphia area, specializing in company relationships with municipal organizations.

Mr. Mulrain

★ ANDREW W. MULRAIN, formerly New York City sanitation commissioner, has been appointed consultant to L. A. Young Spring and Wire Corporation, principally with their Daybrook Hydraulic Division of Bowling Green, Ohio. He is a frequent contributor to PUBLIC WORKS Magazine. He has twice been cited by the American Public Works Association for outstanding leadership in municipal sanitation, and recently delivered a paper at the World Congress of Public Officials at Frankfort, Germany, on incineration.

★ ROWCO MFG. CO., of Keene, N. H., names Lyle G. Lang, Meriden, Conn., eastern regional sales manager. Russell H. Preihs, Michigan City, Inc., will be Mid-West sales manager.

★ RUDOLPH F. HANSON is designated assistant to the director of sales, materials handling equipment, Ingersoll-Kalamazoo Division of Borg-Warner Corp.

★ WOLVERINE TUBE Division of Calumet & Hecla, Inc., moves to impressive new offices and research center, 17200 Southfield Road, Allen Park, Mich.

★ THE GREEN-HORN HUNTER practically bought out the sporting goods store. Then, lacking a dog, he borrowed one. "How'd my pointer do?" inquired its owner later.

"Oh, all right. At first he'd stop every so often and stand still with his nose and tail pointing straight out. But a couple of swift kicks in the rear and I soon cured him of *that.*"

—Jack Sterling on CBS

LOCK JOINT ECONOMIES: *One of a Series*

It's a bargain!

If Peter Minuit were alive today probably nobody would be more surprised than he at the extent of the bargain he made with the Indians for Manhattan. His $24 investment now has an assessed valuation of more than $7,000,000,000.

But no one should be surprised at the value offered by LOCK JOINT CONCRETE PRESSURE PIPE. For a great many years the low first cost of this pipe has been assured by keen competitive bidding, its simplicity and speed of installation have helped to reduce construction costs, its record for dependable, trouble-free service has been unexcelled and its operational and maintenance costs have been minimal.

What more can you ask in the way of a bargain? Highest quality, low cost, best service, least maintenance — that's LOCK JOINT CONCRETE PRESSURE PIPE.

LOCK JOINT PIPE CO.

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo. • Perryman, Md.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous

When you plan your new facilities, include W & T Equipment, both Chlorinators and Dry Chemical Feeders.

"... this is where we plan to put the W & T Dry Chemical Feeders."

When you plan your new plant or the expansion of your present one, be sure to plan a place for W&T Dry Chemical Feeders as well as Chlorinators. W&T Feeders are used for every type of dry feeding problem found in water and sewage treatment plants.

W&T makes both volumetric (volume measurement) and gravimetric (weight measurement) feeders. There is a feeder for any size job, from small equipment to measure out ounces, to accurate giants capable of handling thousands of pounds per minute.

To find out more about W&T Dry Chemical Feeders, write for bulletin S-120. Or let us know the type of feeder problem you have, so we may send publications describing the W&T equipment best suited for your job.

WALLACE & TIERNAN INCORPORATED

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